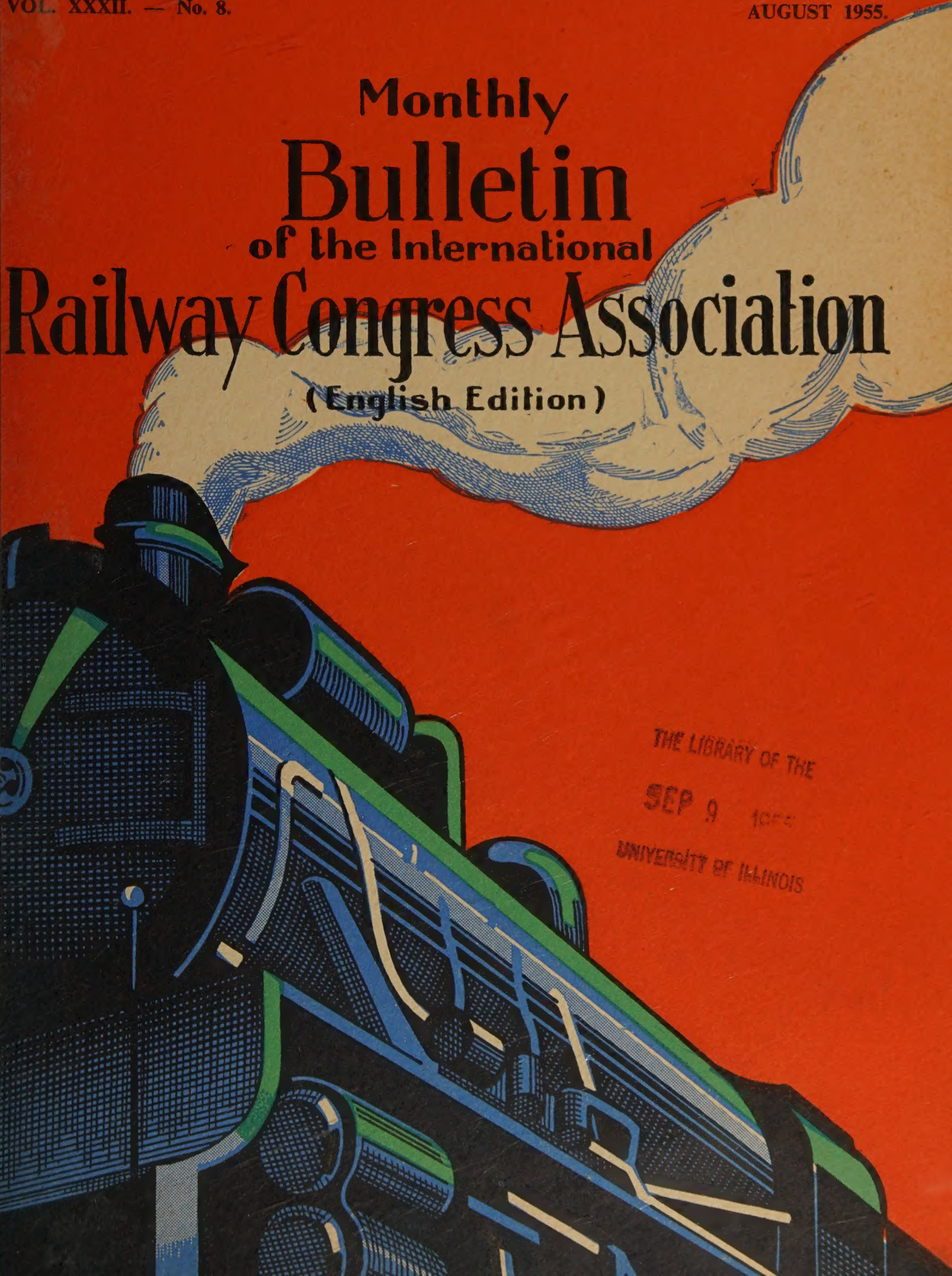
6.06
T

VOL. XXXII. — No. 8.

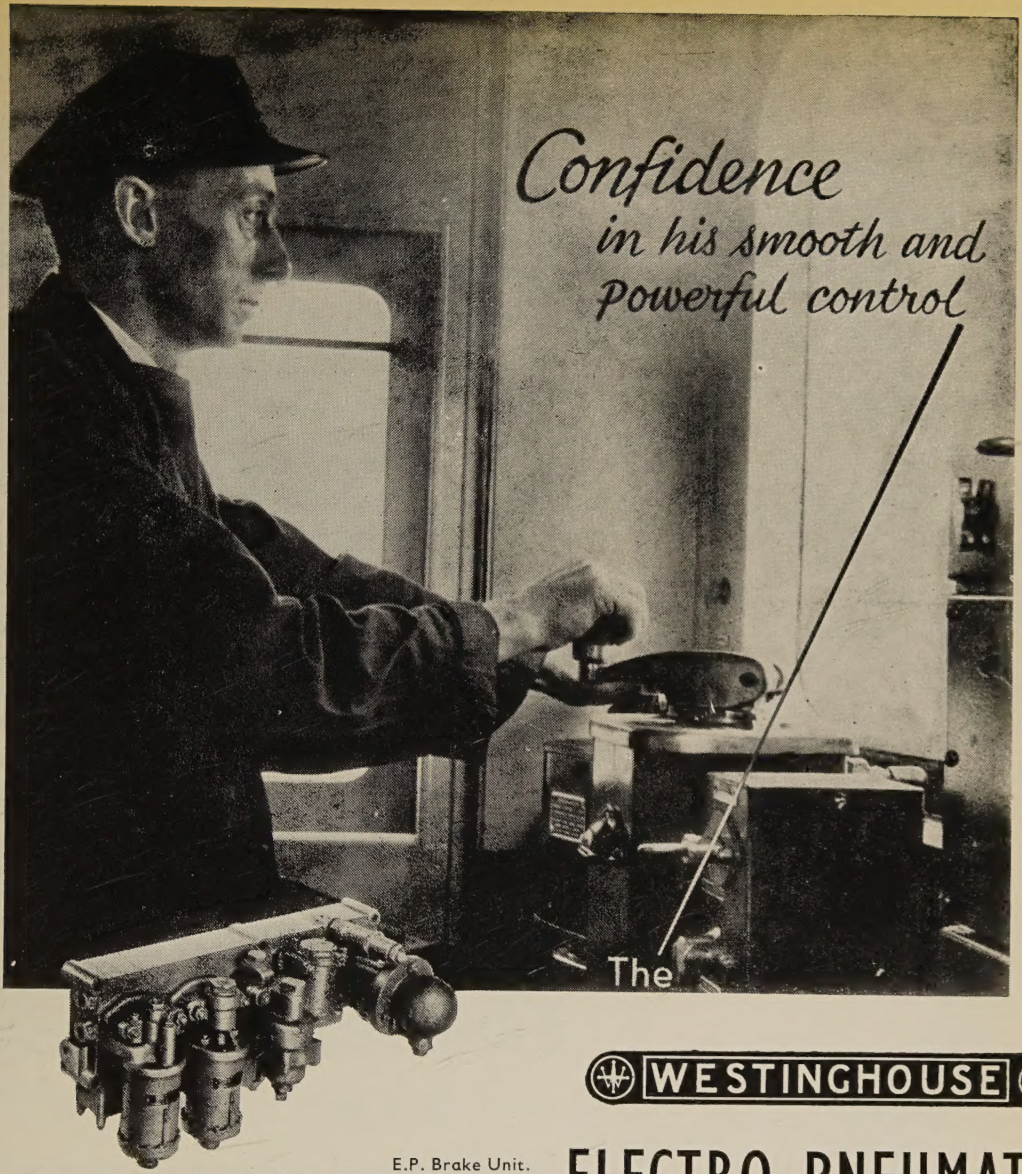
AUGUST 1955.

Monthly Bulletin of the International Railway Congress Association

(English Edition)



THE LIBRARY OF THE
SEP 9 1955
UNIVERSITY OF ILLINOIS



E.P. Brake Unit.
The heart of the system — the assembly of E.P. and other valves mounted on a pipe bracket — all easily removable without breaking pipe joints

Now in Service in

England London Transport Tube Trains
Southern Region :
Eastern Region : Liverpool Street — Shenfield
London Midland Region : Wirral—Liverpool—Southport
London Midland & Eastern Regions : Manchester—Sheffield—Wath
North Eastern Region : Tyneside

India Government Railways (G.I.P.R. & B.B. & C.I.R.)

South America Sao Paulo

Poland Warsaw

Australia New South Wales

New Zealand State Railways

Canada Toronto Subway

WESTINGHOUSE

ELECTRO-PNEUMATIC BRAKE

the brake that complements modern electric stock acceleration, and enables fast passenger trains to be run safely on a short headway.

Westinghouse Brake & Signal Co. Ltd., 82, York Way, Kings Cross, London, N.1

DE DIETRICH

& Co.

Niederbronn-les-Bains
France
Established 1684
Paris office : 2, rue de Leningrad (VIII^e^)

ATELIERS DE CONSTRUCTION DE REICHSHOFFEN-USINES (BAS-RHIN)

★

RAILCARS

★

MOTOR BAGGAGE VANS

★

SHUNTING LOCOS

★

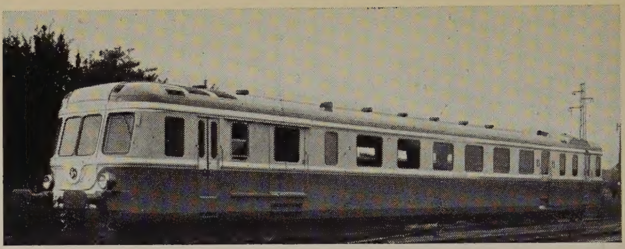
PASSENGER COACHES

★

WAGONS

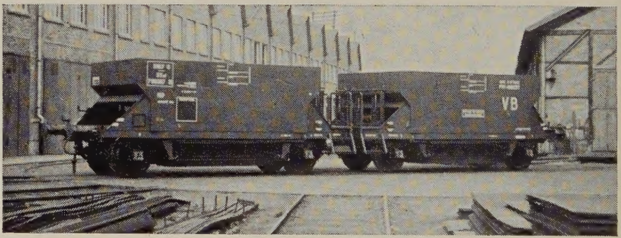
★

TRACK EQUIPMENT

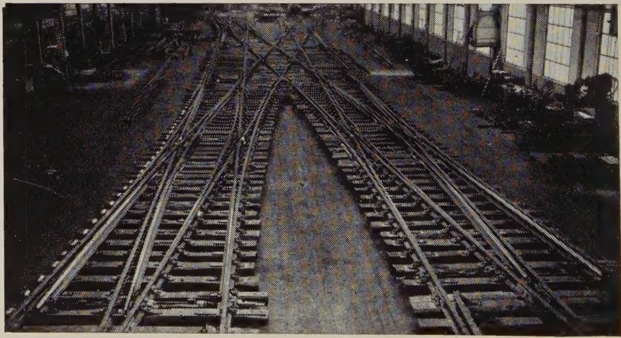


RAILCAR 600 H.P. STANDARD GAUGE, FOR LONG RUN TRAIN SET SERVICE

RAILWAY MOTOR TRACTOR, 150 H.P., STANDARD GAUGE



SELF DISCHARCHING BALLAST DOUBLE WAGON, STANDARD GAUGE, CAPACITY 44 m^3



CROSS-OVER CONSTITUTED BY 4 DOUBLE JUNCTION CROSSINGS

STEEL, PEECH & TOZER *for* RAILWAY MATERIALS

wherever there are railways

The Steel, Peech & Tozer plant produces tyres, disc wheel centres, solid wheels, finished wheel and axle sets, straight and crank axles and laminated springs for railway locomotives, carriages and wagons. These products are known all over the world —'wherever there are railways'.

THE UNITED STEEL COMPANIES LTD

STEEL, PEECH & TOZER - THE ICKLES - SHEFFIELD, ENGLAND

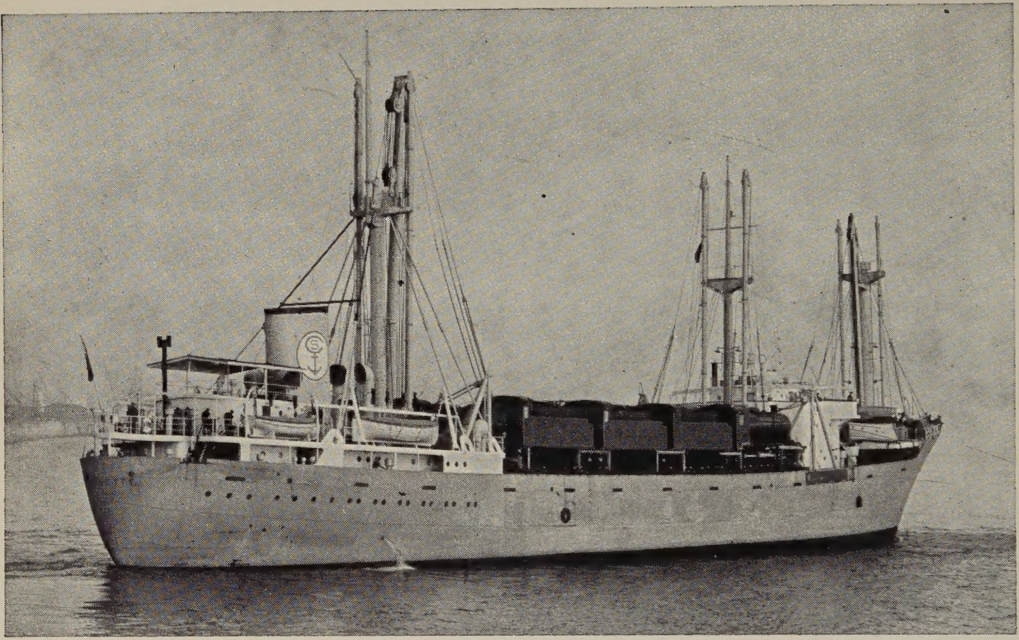
Branch of The United Steel Companies Limited

Telegrams : 'Phoenix, Sheffield' *Telephone : Sheffield 41011 ; Rotherham 5421*

SP 165

BELSHIPS COMPANY LTD. SKIBS A/S

Managers: CHRISTEN SMITH & CO., OSLO *Telegrams:* CHRISSMITH-OSLO



"Belbetty" carrying a cargo of locomotives and tenders for the Egyptian State Railways

- Special ships for heavy-lift transportation
- Derricks capable of lifting up to 200 tons
- Transport to any part of the world
- Delivery of railway units ready for immediate service

●

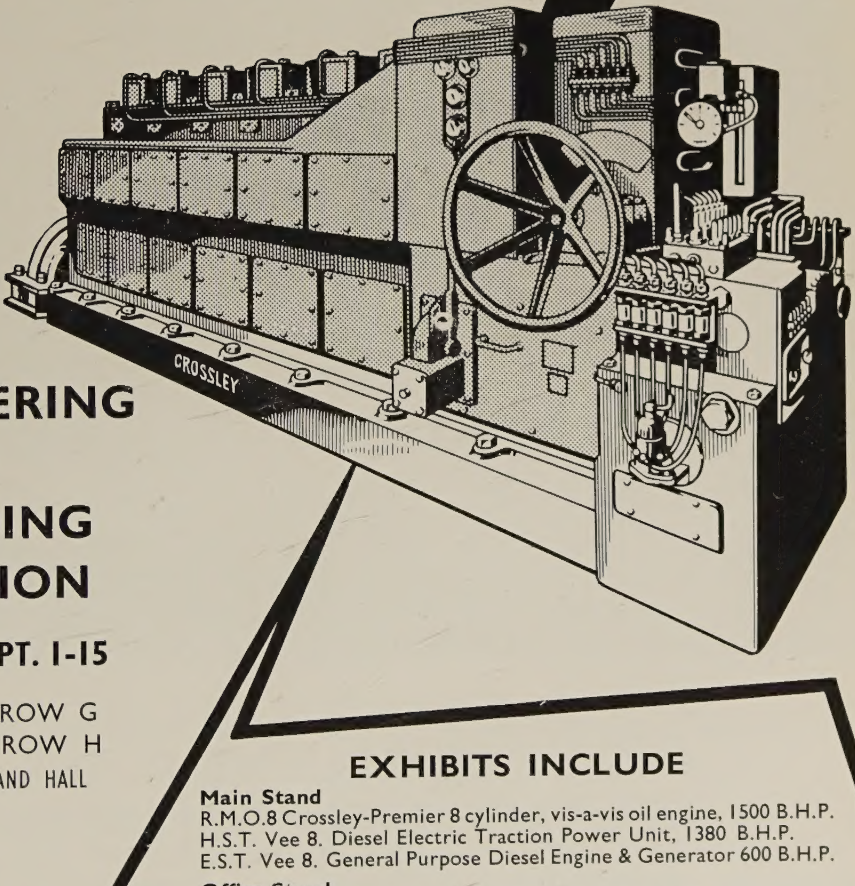
AGENTS:

BELSHIPS COMPANY LIMITED

39 VICTORIA STREET, LONDON S.W.1

Phone: ABBey 6477 *Telegrams: BELSHIPS, SOWEST, LONDON*

CROSSLEY
ENGINES



at the
ENGINEERING
MARINE
& WELDING
EXHIBITION

OLYMPIA · SEPT. 1-15

STANDS No. 12 ROW G
No. 14 ROW H
GROUND FLOOR · GRAND HALL

EXHIBITS INCLUDE

Main Stand
R.M.O.8 Crossley-Premier 8 cylinder, vis-a-vis oil engine, 1500 B.H.P.
H.S.T. Vee 8. Diesel Electric Traction Power Unit, 1380 B.H.P.
E.S.T. Vee 8. General Purpose Diesel Engine & Generator 600 B.H.P.

Office Stand
H.R.N.6. Marine Propulsion Diesel Engine. 670 B.H.P.
X.V.D.6. Four-cycle, Medium Speed, Diesel Engine & Generator. 330 B.H.P.
Also part of a 2-cycle engine to demonstrate remote control.

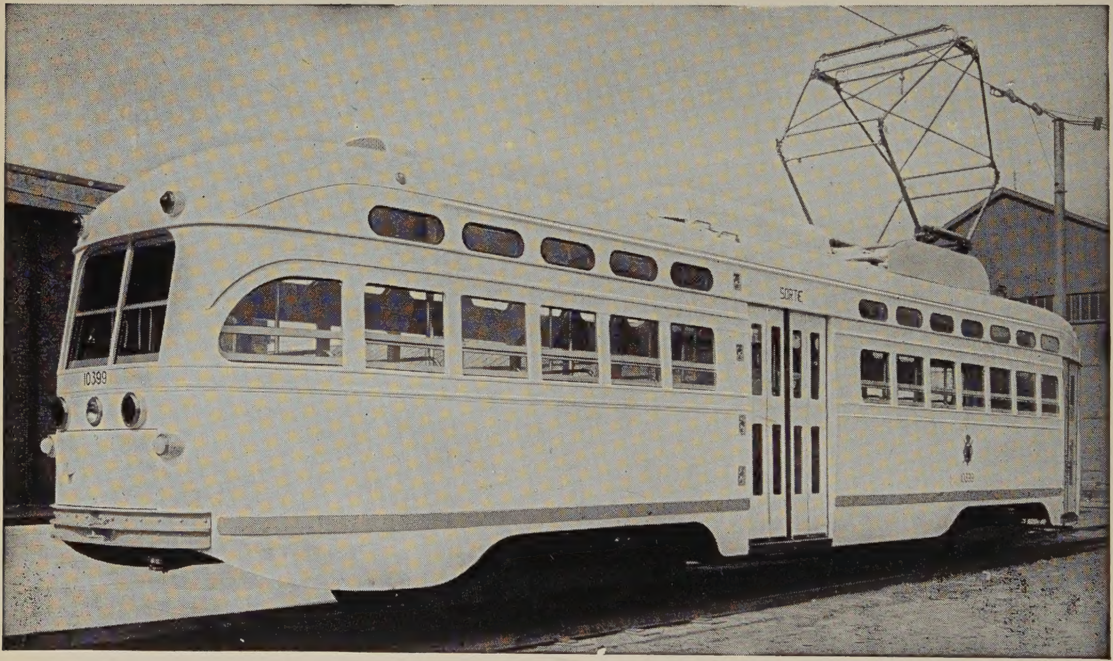
CROSSLEY BROTHERS LTD · OPENSHAW · MANCHESTER 11
London office : Langham House, 308 Regent St., W.1.

C383

LA BRUGEOISE ET NICAISE & DELCUVE

LIMITED LIABILITY COMPANY

Steel-works, Forges and Engineering Works
Head-Office and General Direction at
St-Michel near Bruges



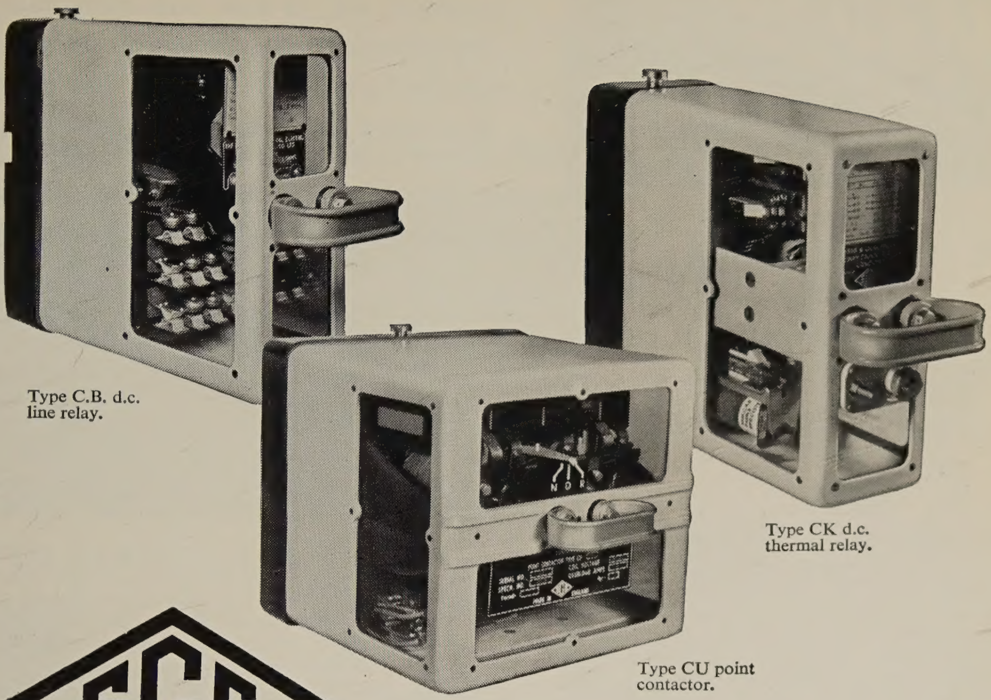
ALL ROLLING STOCK
AND FIXED EQUIPMENT FOR
RAILWAYS AND TRAMWAYS

BRIDGES, FRAMEWORKS, TANKS, GAS-HOLDERS AND ALL STEEL CONSTRUCTIONS RIVETED AND WELDED

●

WHEEL SETS — STEEL CASTINGS — IRON FOUNDRY
SPRINGS

No better relays are manufactured . . .



Type C.B. d.c. line relay.

Type CK d.c. thermal relay.

Type CU point contactor.

PLUG-IN RELAYS
have many ADVANTAGES

- **Space saving compactness.**
- **Speedily removable.**
- **Compliance with relevant British Standards.**
- **Protection against incorrect plugging.**
- **Colour identification.**
- **Robust metal cover with windows giving clear view of interior.**

PLUS the special qualities only to be found in S.G.E. relays

The S.G.E. range of plug-in relays include d.c. track, line, slow-acting polarised, neutral polar, interlocking, time element, and a.c. track, line, slow-acting, three position types. Many hundreds of S.G.E. plug-in relays have been made for use in Canada, Rhodesia and Spain, and now are available to the home railway.

SGE SIGNALS

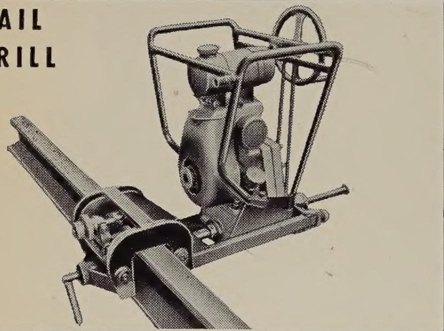
THE SIEMENS AND GENERAL ELECTRIC
RAILWAY SIGNAL COMPANY LTD.
EAST LANE · WEMBLEY · MIDDLESEX

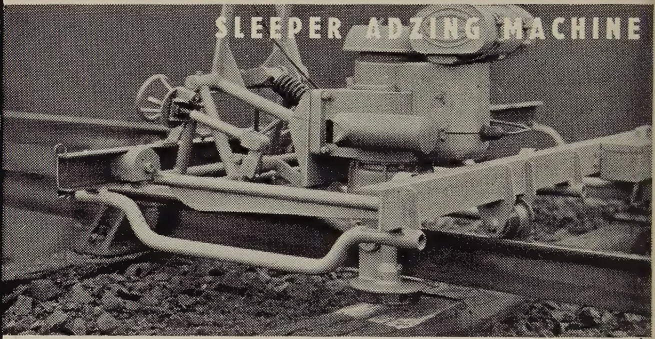
Matisa

AUXILIARY EQUIPMENT

All items of the Matisa range of track maintenance equipment are designed to save maintenance costs and to increase labour productivity :

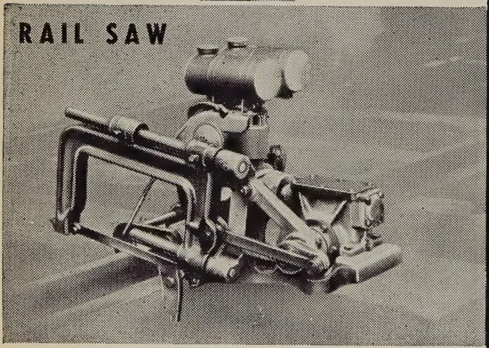
RAIL DRILL



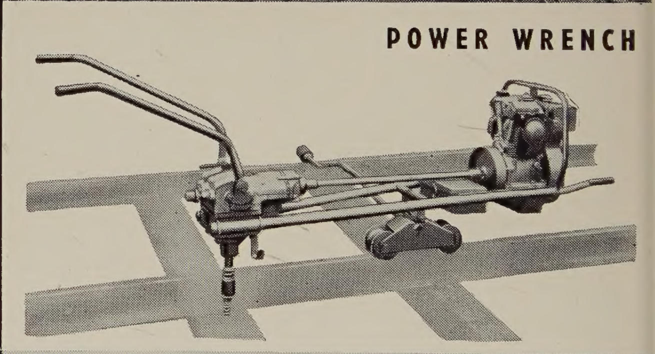


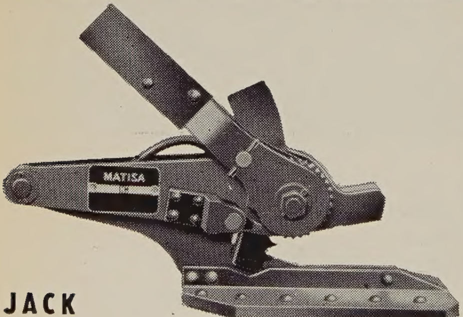
SLEEPER ADZING MACHINE

RAIL SAW

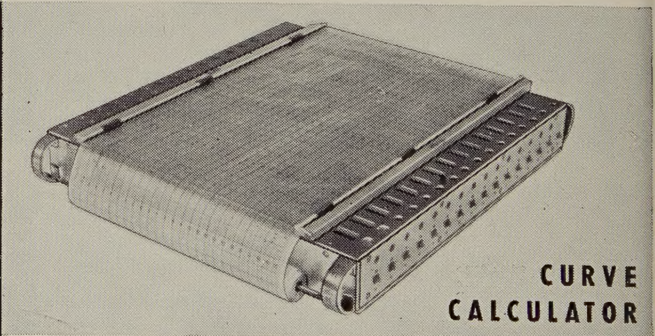


POWER WRENCH





JACK



CURVE CALCULATOR

Matisa

MATISA EQUIPMENT LIMITED
78, BUCKINGHAM GATE, LONDON, S.W.1.

TRACKWORK SPECIALISTS ALL THE WORLD OVER

Licensees from MATERIEL INDUSTRIEL S. A. LAUSANNE - Switzerland

Bulletin of the International Railway Congress Association

CONTENTS OF THE NUMBER FOR AUGUST 1955

1955 **385** (06. 112
Bull. of the Int. Ry. Congr. Ass., No. 8, August, p. 551.
Sixteenth Session, London : 19th. to 26th. May 1954. — **General proceedings in sections and in plenary meetings** (5th. Section : *Light Railways and Colonial Railways*). (23 000 words.)

1955 **621** .135.4, **625** .143.3 & **625** .215
Bull. of the Int. Ry. Congr. Ass., No. 8, August, p. 553.
Wear of rails on curves : *a)* **characteristics of track-laying on curve and details of the rolling stock liable to cause premature wear of the rails;** *b)* **running effects of locomotives and motor coaches with motor bogies;** *c)* **results of the investigations made and proposed remedies. Use of rail-lubrication processes.** (Question 10, 16th. Congress). *Discussion.* (15 000 words.)

1955 **621** .33
Bull. of the Int. Ry. Congr. Ass., No. 8, August, p. 584.
Protection of overhead lines, substations, locomotives and motor-coaches against accidents of electric nature (excess voltage, overloads, short-circuits and lightning). (Question 11, 16th. Congress.) *Discussion.* (8 000 words.)

1955 **625** .233 (493)
Bull. of the Int. Ry. Congr. Ass., No. 8, August, p. 600.
MEYER (E.). — **The latest electric heating and electric heating control devices applied by the Belgian National Railways.** (3 500 words.)

1955 **656** .2 (68)
Bull. of the Int. Ry. Congr. Ass., No. 8, August, p. 607.
DU PLESSIS (D.H.C.). — **A full programme for South African Railways.** Expression of confidence in rail transport. (2 800 words & figs.)

1955 **621** .338 (494)
Bull. of the Int. Ry. Congr. Ass., No. 8, August, p. 613.
Torsion bar bogies on the Rhaetian Railway. Swing bolster sprung by transverse torsion bars. (500 words & figs.)

1955 **625** .245 (45)
Bull. of the Int. Ry. Congr. Ass., No. 8, August, p. 616.
New ore hopper in light alloys for the transport of coal. (700 words & tables.)

1955 **625** .162 (73)
Bull. of the Int. Ry. Congr. Ass., No. 8, August, p. 618.
Whistle and radio control of level crossing gates. Installations on important connecting railway lines in the East and South of U.S.A. (800 words and figs.)

1955 **625** .28
Bull. of the Int. Ry. Congr. Ass., No. 8, August, p. 620.
NEW BOOKS AND PUBLICATIONS : **Dieselfahrzeuge im Schienenverkehr. Eine vergleichende Betrachtung gegenüber Dampf- und elektrischer Zugförderung.** *(Diesel vehicles in railway traffic. Comparison with steam and electric traction.).* Report by the Labour Community « Diesel transport on rail ». (500 words.)

1955 **385** (09.3 (481)
Bull. of the Int. Ry. Congr. Ass., No. 8, August, p. 621.
NEW BOOKS AND PUBLICATIONS : **Vårt Yrke. Jubileumsnummer 1854 — Hundre Ar — 1954.** *(Our Profession. Jubilee Number. One hundred years 1854-1954).* (200 words.)

1955 **313 : 656** (494)
Bull. of the Int. Ry. Congr. Ass., No. 8, August, p. 621.
NEW BOOKS AND PUBLICATIONS : **Schweizerische Verkehrsstatistik.** *(Swiss Transport Statistics.)* (200 words.)

MONTHLY BULLETIN

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(ENGLISH EDITION)

PUBLISHING and EDITORIAL OFFICES : 19, RUE DU BEAU-SITE, BRUSSELS

Yearly subscription for 1955 : **Belgium . . . . 700 Belgian Francs**
Universal Postal Union . . 800 Belgian Francs

Price of this single copy : 80 Belgian Francs (not including postage).

Subscriptions and orders for single copies (January 1931 and later editions) to be addressed to the General Secretary, International Railway Congress Association, 19, rue du Beau-Site, Brussels (Belgium).

Orders for copies previous to January 1931 should be addressed to Messrs. Weissenbruch & Co. Ltd., Printers, 49, rue du Poinçon, Brussels.

Advertisements : All communications should be addressed to the Association, **19, rue du Beau-Site, Brussels.**

CONTENTS OF THE NUMBER FOR AUGUST 1955.

CONTENTS	Page.
I. Sixteenth Session London : 19th-26th May 1954. **General Proceedings in Sections and in Plenary Meetings.** SECTION V : *Light Railways and Colonial Railways.* **Inaugural Meeting of the 5th Section**	551
QUESTION 10. — **Wear of rails on curves : *a)* characteristics of track-laying on curve and details of the rolling stock liable to cause premature wear of the rails; *b)* running effects of locomotives and motor coaches with motor bogies; *c)* results of the investigations made and proposed remedies. Use of rail-lubrication processes.**	553
QUESTION 11. — **Protection of overhead lines, substations, locomotives and motor-coaches against accidents of electric nature (excess voltage, overloads, short-circuits and lightning)**	584
II. **The latest electric heating and electric heating control devices applied by the Belgian National Railways,** by E. MEYER	600
III. **A full programme for South African Railways.** Expression of confidence in rail transport, by D.H.C. DU PLESSIS	607

CONTENTS *(continued)*. Page.

VI. **Torsion bar bogies on the Rhaetian Railway.** Swing bolster sprung by transverse torsion bar 613

V. **New ore hopper in light alloys for the transport of coal** 616

VI. **Whistle and radio control of level crossing gates.** Installations on important connecting railway lines in the East and South of U.S.A. 618

VII. New books and publications :

Dieselfahrzeuge im Schienenverkehr. Eine vergleichende Betrachtung gegenüber Dampf- und elektrischer Zugförderung. *(Diesel vehicles in railway traffic. Comparison with steam and electric traction.)*. Report by the Labour Community « Diesel transport on rail » 620

Vårt Yrke. Jubileumsnummer 1854. — Hundre Ar — 1954. *(Our Profession. Jubilee Number. One hundred years, 1854-1954.)* 621

Schweizerische Verkehrsstatistik. *(Swiss Transport Statistics.)* 621

VIII. Monthly bibliography of railways 53

LIBRARY

OF THE

Permanent Commission of the International Railway Congress Association

READING ROOM : 19, rue du Beau-Site, Brussels.

Works in connection with railway matters, which are presented to the Permanent Commission are mentioned in the « Bulletin ». They are filed and placed in the library. If the Executive Committee deems it advisable they are made the subject of a special notice. Books and publications placed in the reading room may be consulted by any person in possession of an introduction delivered by a member of the Association.

Books, etc., may not be taken away except by special permission of the Executive Committee.

The Permanent Commission of the Association is not responsible for the opinions expressed in the articles published in the « Bulletin ».

All original articles and papers published in the « Bulletin » are copyright, except with the consent of the Authors and the Committee.

An edition in French is also published.

Vol. XXXII. — No. 8. August 1955.

BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[385 (06 .112]

SIXTEENTH SESSION

London : 19th-26th May 1954.

GENERAL PROCEEDINGS

Section V : LIGHT RAILWAYS AND COLONIAL RAILWAYS

INAUGURAL MEETING

May 20th, 1954, at 9 a. m.

Provisional Chairman : M. Crem,
Vice-President of the Permanent Commission of the Association.

— The meeting began at 9 a.m.

The President (in French). — Gentlemen, the Permanent Commission has made me President for the opening Meeting of the 5th. Section and has suggested that I should ask you to nominate as *President* of your Section Mr. W.A. Vrielynck, Directeur Général Adjoint de la Société Nationale des Chemins de fer Vicinaux de Belgique.

I am sure you all know Mr. Vrielynck. He has accepted on several occasions to be Reporter of the 5th. Section and he has presided with great success over the works of that Section in Rome, in 1950. I think that with your collaboration he will be able to carry through the works of your Section.

I presume, Gentlemen, that you all agree to this proposal. *(Applause.)*

In addition, the Permanent Commission has asked to propose the nomination as *Vice-Presidents* of the following :

Mr. T.C. Courtney, Chairman of the Coras Iompair Eireann, Member of the Permanent Commission of the Association, and

Mr. A. Barbaut, Directeur de la Compagnie Fermière des Chemins de fer Tunisiens, and as *Principal Secretary :*

Mr. N. CHARLIER, Ingénieur à la Société Nationale des Chemins de fer Vicinaux (Belgique).

(Applause.)

— Mr. VRIELYNCK took the Chair.

— The Section, on the proposal of its President, completed its Bureau and drew up its agenda.

Revision of the Rules and Regulations of the International Railway Congress Association.

The President (in French). — Gentlemen, before we start discussing Question 10, we have to nominate a delegate from our Section to take part in the work of the Special Commission responsible for considering a proposal to modify the Rules and Regulations of the Association (1).

I suggest we nominate for this purpose Mr. L. RIPERT, Ingénieur en Chef, Chef du Service de la Voie et des Travaux de la Société Générale des Chemins de fer Economiques, France. *(Applause.)*

— *The Section then began its examination of Question 10.*

---

(1) For the text of the suggested modifications to the Rules and Regulations, see page 989 of the *Railway Congress Bulletin* for September 1954 (Summary of the proceedings of the London Congress, 1954).

[621 .135 .4, 625 .143 .3 & 625 .215]

QUESTION 10.

Wear of rails on curves :

a) characteristics of track-laying on curve and details of the rolling stock liable to cause premature wear of the rails;

b) running effects of locomotives and motor coaches with motor bogies;

c) results of the investigations made and proposed remedies. Use of rail-lubrication processes.

Preliminary documents.

Report (America [North and South], Australia [Commonwealth of], Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by V. VENKATARAMAYYA. (See *Bulletin* for September 1953, p. 533, or separate issue No. 3).

Report (Austria, Belgium and Colony, Bulgaria, Czechoslavakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia), by L. RIPERT. (See *Bulletin* for October 1953, p. 737, or separate issue No. 7.)

Special Reporter : L. RIPERT. (See *Bulletin* for May 1954, p. 583.)

DISCUSSION BY THE SECTION.

Meeting held on the 20th May 1954.

PRESIDENT : W.A. VRIELYNCK.

— The Meeting began at 9.15 a.m.

The President (in French). — Gentlemen, there are two questions on the agenda for this Section : one dealing with the wear of rails on curves, the other with the protection of electrical equipment, particularly in traction substations.

Question 10, the first on our programme, was studied by two Reporters : Mr. VEN-

KATARAMAYYA for the English speaking countries, and Mr. RIPERT for the French speaking countries.

Mr. RIPERT was also appointed Special Reporter. He prepared a remarkable report — a task our French colleagues certainly know how to tackle — cartesian, lucid, well constructed — and I am going to call upon him straight away and ask him if he has any general points to make. After this, I am going to ask him to read the summaries which he formulated in his report.

First of all, however, I would like to know if any of you wish to submit any questions to the Meeting, any question of a general nature not included in Mr. RIPERT's summaries.

— As no one has any point to raise, I call upon the Special Reporter.

Mr. Ripert, *Special Reporter* (in French). — The two reports on Question 10 were based on the information supplied by 34 out of the 104 Administrations consulted. There were therefore a fairly large number of replies to the questionnaire.

In our report, we first of all reported the effects observed in connection with the wear of rails on curves, leaving aside everything of a general nature : undulatory wear, flaking.

Then when considering the causes, we tried to determine the influence of various characteristics of the permanent way and certain features of the rolling stock. Motor bogies were the subject of a special investigation in view of present day interest in them.

The last part of the report deals with the results of research work and the remedies considered.

The summaries apply respectively to the effects noted, the influence of the permanent way, the influence of the rolling stock, and the remedies applied.

The President (in French). — We will now begin our examination of the summaries.

Mr. Ripert (in French). — *Summary 1 :*

1. The characteristic form of wear on a rail of the outer line of curved track is a chamfering of the inner face of the head, the angle of which varies between about 20° to 30° to the centre of the rail. In addition, the running surface is worn on a plane sometimes slightly inclined towards the centre of the track.

The inner line of rail is subject to vertical wear of the running surface, on a plane almost parallel to it.

The finish of surface is usually maintained. Binding is sometimes experienced, accompanied by the shedding of flakes of metal.

The President (in French). — Has anyone anything to say about this first summary?

It is a series of statements about which everyone agrees. I think, therefore, that the Meeting will accept this summary.

Mr. Ripert (in French). — I think it advisable to point out that there is a slight divergency between the two reports about the over inclination of the running surface. Mr. VENKATARAMAYYA mentions that the wear of the running surface of the outer rail tends to increase the over inclination, but only to a very slight extent; on the other hand, according to other information received, this wear may be as much as 3° to 8° to the perpendicular to the axes of the rail; certain profiles show same very clearly.

The President (in French). — Whereas in the English speaking countries, such wear has not been observed?

Mr. Ripert (in French). — It says : « to a very small extent » the effect is not appreciable.

The President (in French). — Can anyone explain why there is this difference between the two groups of countries? Do you know the reason, Mr. VENKATARAMAYYA?

Mr. Venkataramayya, *Indian Government Railways* and *Reporter*. — There is not very much difference between the countries. There was slight inclination of about 2° but, not as much as 8°. There was wear on the horizontal plane, which is slightly inclined, may be about 2°, but not as high as 8°.

The President (in French). — Do you not think that this is because the rails in question have not been laid for long?

Mr. Venkataramayya. — The rails are removed because they chamfer much earlier and in a shorter time — is that what you mean?

The President (in French). — Yes, I suppose you have no observation to make about the practice in other countries?

Mr. Venkataramayya. — I would not know.

Mr. Ripert (in French). — Many Administrations have reported this over inclination. And how did it originate? Wear caused by the wheels along this slope can only be explained by the tipping of the rail. Even when the fastenings are sufficiently tight, there must be a sort of torsion of the rail under the effects of the weight and centrifugal force. The deflection of the head of the rail has even been measured and found to be 1 to 2 mm.

The President (in French). — Does this apply no matter what the radius of the curve, or is it only on curves of small radius?

Mr. Ripert (in French). — The smaller the radius, the greater the wear.

The President (in French). — I think it is very difficult to compare the replies received from different Administrations. The speeds, the weights, the radii are all different. In the replies received, the information is based on different data, and it is in fact this diversity of conditions and circumstances which explains what you pointed out at the beginning.

Mr. Dulieu, *Société Nationale des Chemins de fer Vicinaux, Belgique* (in French). — Have the countries of the two groups adopted the same superelevations and the same gauge widening?

The President (in French). — The superelevations and gauge widenings vary according to the speeds allowed. It is not possible to adapt them for all speeds and all weights; some base their calculations on very high speeds, others on average or low speeds.

Mr. Broca, *French National Railways, Section Secretary* (in French). — Is there not a tendency for the English speaking countries to increase the values of the superelevation and gauge widening?

Mr. Venkataramayya. — I think the effect is more or less uniform as regards superelevation — not much variation. The superelevation is limited in all the countries. The value of the maximum superelevation of the track is determined not for the fastest trains but for some sort of average speed of the traffic. There is not much diversity in the practice as regards these two, superelevation and the widening of the gauge.

The President (in French). — Since the superelevation is calculated for a certain average speed, which may vary from country to country, I think the necessary factors are lacking. Perhaps this is worth further research and a more thorough investigation.

Since no further light can be thrown upon this point, and seeing that everyone is agreed, the first Summary is adopted without alteration, and we will go on to Summary 2.

Mr. Ripert (in French). — *Summary 2 :*

2. The characteristics of track laying considered to have the greatest influence on wear of rails on curve are :

— curvature of the track; lateral wear being particularly marked in curves with radii of less than 600 m (656 yards) standard gauge and 350 m (383 yards) metre gauge;

— insufficient superelevation with lateral wear of the outer rail; excessive superelevation for vertical wear of the inner rail;

— steep down gradients;

— excessive widening of the gauge;

— insufficiently long parabolic curves.

The President (in French). — Has anyone anything to say?

Mr. Ripert (in French). — Everyone obviously agrees about the influence of the curvature.

As regards steep gradients, a distinction should be made between steep up and steep down gradients; in the case of up gradients, the speed of the trains generally does not correspond to the superelevation. There may be excessive wear of the inner rail. There is also the effects of sudden accelerations which may produce shocks on the outer rail, and skidding. On the other hand, on steep down gradients, the speed, the effect of braking, the more marked action of the wheels, all have to be taken into account.

Mr. Broca (in French). — I think these are characteristics of a general order, about which there is not a great deal to say. The ratio between the amount of wear and the curvature might be questioned, since the formulae suggested differ considerably from one country to another.

The President (in French). — This is dealt with in Summary 5. I see that everyone is agreed.

Mr. Meunier, *Franco-Ethiopian Railway, Djibouti to Addis Ababa* (in French). — The value of 350 m for the radius of curvature is no doubt the average based on the information supplied. On our line we find a curve of 300 m quite satisfactory; below this radius we find increased wear, and even cutting away of the rail metal. If this summary is left as it is, it would amount to forbidding us to construct any lines; in fact we find 300 m satisfactory.

The President (in French). — I would even say that on the Belgian Light Railways which I represent, 300 m is found an excellent standard.

Mr. Meunier (in French). — Under these conditions, to say that wear becomes particularly marked after 300 m is rather too precise a statement.

The President (in French). — I quite agree with you, and from my own personal experience, I would say that this is already a very good radius. It all depends upon the speed at which trains run over these lines.

Mr. Meunier (in French). — We do not exceed 50 km (31 miles)/h.

The President (in French). — Whereas we are considering much higher speeds in this case and much heavier trains. I think it would be better not to give any figures.

Mr. Broca (in French). — We might perhaps say : « ... begins to be felt after 350 m ».

Mr. Meunier (in French). — The authorities must not get the idea that this figure is an absolute one.

Mr. Ripert (in French). — The radius varies very greatly, and I would like to recall in this connection the data given in the table in my report (*). For the D.B. 700 m, for the S.N.C.F. 1 000 m, etc.

The President (in French). — This is all due to the fact that we are dealing with Railways of completely different characteristics from the point of view of speed, weight, traffic, curves, etc.

Under these conditions, I think we might say : « the curvature of the line; lateral wear is increased when the radii of curves are less than 600 m on lines with heavy traffic ».

Mr. Ripert (in French). — The traffic is one factor, but not the only one.

Mr. Richelot, *Belgian Colonial Transport Office* (in French). — Could we not say 300 m instead of 350 m? On our lines, we go as low as 150 m. After 500 m wear begins to show, but it is greatly increased after 300 or 350 m. Consequently with curves of 150 m radius, with our traffic, the wear becomes extremely important.

Mr. Meunier (in French). — We could say the same. The track lasts about two years.

The President (in French). — Perhaps we could say : « ... lateral wear becomes more marked on curves of radius of less than 600 m on standard gauge lines and 300 m on metric gauge lines ».

Mr. Ripert (in French). — I would remind you that the Austrian Federal Railways stated that the radius after which wear becomes apparent is a function of the speed for $\left(\frac{R}{V} = 10\right)$.

The President (in French). — Perhaps they have been able to make some very accurate observations, but I doubt whether such observations can be very systematic in this connection, and I think it would

---

(*) See *Congress Bulletin* for October 1953, p. 744.

be dangerous to adopt this conclusion. The speed after all is only one factor.

I suggest we adopt this summary with 300 m instead of 350 m. Have you any objection to 300 m, Mr. VENKATARAMAYYA?

Mr. Venkataramayya. — It is not a minimum radius. It only states here that the wear is very marked, particularly marked, when the radius is sharper than 350 m. Even for curves of 350 m there is marked wear and it is lateral wear. It is not the minimum, but for curves of lesser radius than 350 m, wear is particularly marked. There is definite wear. I do not know whether we should reduce this figure beyond 350 m.

This summary does not prevent anyone laying curves sharper than this radius. It only mentions that the wear is greater, very particularly noticeable, in curves sharper than this. For instance, for standard gauge there are many curves sharper than 600 m — many curves are laid sharper than 600 m.

Mr. Meunier (in French). — In fact the difference is due to the expression : « particularly marked ». What is meant by « particularly marked wear »?

The President (in French). — To get everyone into agreement, could we not say : « Lateral wear being appreciable » instead of « ... lateral wear being particularly marked on curves of 600 m standard gauge and 300 m metre gauge ».

Mr. Meunier (in French). — I would suggest : « ... metre gauge with heavy, fast traffic ».

The President (in French). — We are therefore all agreed basically, but we must find a formula acceptable to everyone, and I therefore suggest : « ... 350 m for metre gauge lines with heavy traffic ».

But I think it is very hard to separate the two.

Mr. Broca (in French). — It is a matter of listing the conditions. Perhaps we could add :

« ... the figures may vary according to the traffic and speed conditions ».

Mr. Venkataramayya. — I have no objection, but this deals with the characteristics of track. Why should we bring in the question of speed and traffic here? It is just the question of characteristics of track alone we are dealing with in this paragraph. Why not just leave it as it is? We can put in the word « appreciable » in place of « particularly marked » and leave it there instead of bringing in the traffic and speeds. That is dealt with later on.

The President (in French). — Since we are not all in complete agreement, we will put the matter to the vote. I suggest retaining « 350 m » and adding : « ... for metre gauge lines with fairly important traffic ».

I think we might end with this text. Summary 2 will therefore read :

« 2. The characteristics of track laying considered to have the greatest influence on the wear of rails on curves are :

« — the curvature of the track; lateral wear being appreciable in curves with radii of less than 600 m (656 yards) standard gauge and 350 m (383 yards) metre gauge with fairly important traffic;

— « insufficient superelevation with lateral wear of the outer rail; excessive superelevation with vertical wear of the inner rail;

« — steep down gradients;

« — excessive widening of the gauge;

« — insufficiently long parabolic curves. »

— *Adopted.*

Mr. Ripert (in French). — *Summary 3 :*

3. The features of rolling stock which have a predominant influence on the wear of curved rails are principally those which affect the angle of thrust of the wheel on the rail; long rigid wheelbase, or on the contrary an insufficiently long wheelbase, total play of the axle in the track, longitudinal or lateral play of the axleboxes, lateral play of journals.

Amongst other causes of wear may be mentioned : the stiffness of some bogie or bissel side control arrangements, amount of unsprung masses, diameter of wheels. Small diameter wheels cause higher stresses and heavier hammer-blows at rail gaps than wheels of large diameter.

The President (in French). — Any comments?

— *Summary 3 is adopted without discussion.*

Mr. Ripert (in French). — *Summary 4 :*

4. The effects of locomotives and motor coaches with driving bogies are the object of varying views. Whilst some Administrations have not noticed any harmful results, others consider them to be particularly aggressive and to produce lateral rail wear which is much heavier than that caused by carrying bogies or by certain long wheelbase vehicles.

These effects are attributed principally :

— to the amount of the axle load and especially to the unsprung mass (particularly of nose-suspended traction motors);

— to the increased rate of acceleration and speed;

— to asymmetrical motor couple.

They show themselves particularly in track irregularities.

The President (in French). — This summary does not express the general opinion, as opinions vary from railway to railway.

From the replies you received, Mr. RIPERT, can you see what is the differentiation?

Mr. Ripert (in French). — The number of pairs of wheels of the bogies seems to be an important factor. It is the case for example with the six wheeled bogies of the Algerian, Camerouns, Matadi-Leo and Franco-Ethiopian Railways.

The increased wear of the rails appears to be due to the middle pair of wheels which have the effect of increasing the pressure of the axle of the guiding flange.

Mr. Meunier (in French). — Good results have been obtained by suppressing play in the carrying axle; there is less wear if it is made rigid, without any lateral play. This has considerably improved the situation.

The President (in French). — Is the fact that there are six wheeled bogies the cause of the differentiation?

Mr. Ripert (in French). — It is one factor. As regards four wheeled bogies, it is thought that motor bogies are usually and generally less agressive than carrying bogies.

Moreover, it is often found that motor bogies float in the track; we say that « they have a crab-like movement ». What is the cause of this? Probably (as stated in the summary) to asymmetrical motor couple.

Certain Railways have pointed out that these effects are noticeable essentially with irregularities in the track; if the track is perfect, the motor bogie theoretically is not particularly aggressive; but it is when there are any faults in the track.

The President (in French). — Maintenance plays a very important part in all these questions. A very well maintained track will certainly show less wear than one which is poorly maintained. Opinions may vary from railway to railway according to the importance attached to maintenance. This varies in terms of the traffic and other factors as well.

Are not differences of opinion likely to be due to the fact that experience is shorter on one railway compared with another?

Mr. Ripert (in French). — Certainly. Moreover, the loads and speeds often differ considerably. When electric traction or Diesel traction is substituted for steam traction, the speeds and the driving axle loads are generally increased.

The President (in French). — I think that it is lack of experience on certain railways that is to blame. We will have to wait a few years till these ideas are more definite. We are in a period of evolution, and it will only be possible to arrive at well founded conclusions in a few years time.

We can agree the summary in its present form in view of the fact that divergences of opinion are due above all to differences in maintenance, to lack of experience, and the question can be gone into again at a later Session. Does everyone agree?

Mr. Venkataramayya. — In some countries cyclic wear has been reported due to these motor bogies. It is not uniform, but cyclic, about 50 feet apart. It was serious on one or two railways in India at one time.

The President (in French). — I do not think this remark affects the summary in its present wording; so I think we can keep it as it is.

Mr. Ripert (in French). — The question of the suspension is rather important. Perhaps it would be advisable to reread some of the summaries referring to nose suspended motors adopted when this question was discussed at the Rome Congress (1950 — Question 6). In particular, it was stated :

« Nose suspension inevitably causes vertical and lateral shocks to the track by reason of the unsprung weight of the motors. The progressive wear on rail and flange only aggravates the trouble... Choice between the different systems of transmissions will be dictated by local conditions : if the track is sufficiently robust and well maintained, nose suspension may be used without great disadvantage; if the track is weaker, it is desirable to use one of the systems employing resilient transmission and frame mounted motors if possible. »

Universal coupling of the bogies is one way of overcoming this irregular running of the motor bogies, or at least of regulating their running by decreasing their floating movements.

The President (in French). — It is my impression that no Administration has had the possibility nor the occasion of carrying out trials and close observations in this field, because the practice is too recent, and this would require long and systematic observations. Obviously in this case it is not a question of laboratory studies, and I think we should leave the summary in its present form.

Mr. Ripert (in French). — It might be stated though that the opinions expressed regarding the wear due to motor bogies is based on the wear of the tyres.

The President (in French). — It would be interesting to know if any railway has any experience of tyres with rubber or of track laid with rubber inserts. I must repeat, these matters are too recent, so that no definite opinions can be expressed about them. They might perhaps form the subject of a new question to be included in the agenda of a future congress.

We will therefore leave Summary 4 as it is, and go on to Summary 5.

Mr. Ripert (in French). — *Summary 5 :*

5. As the factors which influence the wear of rails in curves are numerous, it is difficult to separate any one of them from the whole. The quality of maintenance must also be taken into account.

It is generally admitted that the reduction in rail section, in a curve of radius R, increases as a function of :

— the curvature, in a proportion between $\frac{K}{R}$ and $\frac{K}{R^2}$;

— the axle load and the speed of operation;

— the angle of thrust of the guiding axle.

The President (in French). — Any comments ?

Mr. Venkataramayya. — In this summary I suggest that instead of saying « It is generally admitted that the reduction in rail section... » it should read « It is generally admitted that the lateral wear... ». It is not so much a reduction of total section of rail but the lateral wear which is proportional to $\frac{K}{R}$ and $\frac{K}{R^2}$.

For the words « reduction in rail section » I would suggest « lateral wear ».

The President (in French). — Do you agree, Mr. Ripert ?

Mr. Broca (in French). — The remarks concern the wear of the outer rail in particular.

The President (in French). — This precision is to the point and we might say :

« It is generally admitted that the *wear of the outer rail* in a curve... »

Mr. Venkataramayya. — In the last line the angle of thrust of the guiding axle only is mentioned, but any other axle of the locomotive can cause wear. The guiding axle may be a bogie axle but the coupled axle which causes very high lateral force may be the cause of lateral wear. Why don't we say « the angle of thrust under lateral force », not « the guiding axle », because it is not the guiding bogie only.

The President (in French). — Does everyone agree to this suggestion?

Mr. Richelot (in French). — We have found that the centre axle gets much less wear than the others, so I wonder if we should not say « outer axles ».

The President (in French). — What do you think, Mr. MEUNIER?

Mr. Meunier (in French). — On our system, the centre axle was very worn, but when we made it rigid, the wear disappeared, which agrees with what Mr. RICHELOT has stated.

The President (in French). — We have said : « ... the angle of thrust under the effects of the lateral force of the axles ».

This should not affect the summary as worded, so we will keep to this formula.

Mr. Ripert (in French). — The angle of thrust also depends on the curvature.

The President (in French). — It supposes a given curvature. As we have already spoken of the curve, I do not think there are any objections?

Mr. Broca (in French). — I think we are combining two different things : it is a purely geometrical question.

The President (in French). — Let us say, therefore, the angle of thrust of the axles. *(Agreed.)*

— *The final text of summary 5 will be given at the Meeting on May 21st.*

Mr. Ripert (in French). — *Summary 6 :*

6. The limits of lateral wear and that on the running surface have been established on the basis of experience, taking into account the reduced strength of the rail.

It is only in exceptional cases that chamfering of the worn head of the outer rail has been admitted as a decisive factor in derailments caused by the flange mounting the rail.

The President (in French). — I do not think there are any comments to be made about this.

Mr. Meunier (in French). — We have found such extensive wear of the rails on curves that only half the head remained, but this still did not cause derailments. This therefore agrees with the summary.

The President (in French). — We can take it therefore that Summary 6 is *approved* and go on to Summary 7.

Mr. Ripert (in French). — *Summary 7 :*

7. To combat wear of rails in curves, the following methods are adopted :

— reduction in widening of the gauge, and modification of the superelevation;

— laying of a check-rail along the inner line;

— use of rails with a high resistance to wear;

— lubrication of rails.

On several Railways, the life of rails is extended where one lateral face of the head is worn by reversing them end to end, by changing them over to the other line of rail, or by relaying them in tracks of less importance.

The President (in French). — Has anyone anything interesting to say about this?

Mr. Pialoux, *French Equatorial Africa and Cameroun Railways* (in French). — I think it should be made clear that the reduction in the widening of the gauge should not be carried too far, because if it is there will be increased wear. There is an optimum widening which should be retained, otherwise there is too much wear.

Mr. Ripert (in French). — We go back to the question of widening the gauge in Summary 8.

The President (in French). — Perhaps it is dangerous merely to say that it is sufficient to reduce the gauge widening to prevent wear of the rails on curves. We might say : « ... adaptation of the gauge widening » or « ... modification of the gauge widening ».

Mr. Ripert (in French). — Or « modification of the gauge widening and the superelevation of the track ». The question of the widening of the gauge is examined more particularly in Summary 8. Summary 7 is an enumeration of all the methods of combating wear of the rails, and mention is also made of reversing them. Reversing gives a rail profile similar to that of a gendarme's hat, which is rather characteristic and picturesque.

— *The final text of Summary 8 will be given at the Meeting on May 21st.*

Mr. Ripert (in French). — *Summary 8 :*

8. The degree of gauge-widening given to track has been reduced on some lines, with the aim of lowering the angle of thrust and reducing oscillation, as far as compatible with the free inscription of vehicles in the curve. Attempts have been made to achieve a closer relationship between superelevation and operating speeds.

The President (in French). — Does everyone agree?

Mr. Venkataramayya. — « The degree of gauge widening » should be changed to « The extent of gauge widening ».

The President — It is a question the translation. I would like to know if our English colleagues prefer « extent » to « degree »? Do you agree « extent » is better? Well then, we will say « extent ».

— *The French text of Summary 8 remains unaltered.*

Mr. Ripert (in French). — *Summary 9 :*

9. A check-rail is sometimes laid along the inner line of certain particularly sharp curves, but this seems to be essentially a safety measure. The check-rail has, in fact, the drawbacks of causing supplementary wear on the inner surface of tyres and increasing resistance to movement.

Mr. Meunier (in French). — If this summary is adopted as it stands, it formally condemns the use of check-rails, without counting the wear of the check-rail which is not mentioned.

Mr. Ripert (in French). — It may be said that the check-rail is chiefly used for safety reasons to reduce the lateral wear of the rail. Its drawbacks as regards maintenance of the permanent way make it of little value.

Mr. Meunier (in French). — It wears itself; it gives rise to other wear.

The President (in French). — I think the wording should be modified. The fact that you reported just now that the surface could be reduced by as much as one half without inconvenience from the point of view of the risk of derailment, seems to condemn the use of check-rails.

Would you agree to the following text :

« A check-rail is sometimes laid along the inner line of rails on certain particularly sharp curves for safety reasons. »

Mr. Venkataramayya. — In Summary 7, it was stated that to combat wear of rails the laying of a check-rail along the inner line has been adopted, whereas in Summary 9 it is said « A check-rail is sometimes laid along the inner line of certain particularly sharp curves, but this seems to be essentially a safety measure ». These seem to be contradictory.

The President (in French). — This comment is very much to the point.

Mr. Ripert (in French). — The idea of the width of the flangeway also comes in to show how important a part safety plays in reduction of the wear. For example on the lines of the R.A.T.P. the width of the flangeway is 100 mm, which clearly shows that the check-rail does nothing to reduce wear, it is simply a safety device in case of derailment.

The President (in French). — We could leave the paragraph about laying a check-rail out of Summary 7. In fact Summary 9 condemns check-rails.

Mr. Venkataramayya. — A check-rail reduces the lateral wear and is also a safety measure. It reduces the wear on the outer rail and is also a safety measure to prevent derailments — it serves both purposes.

The President (in French). — Naturally, I think it does reduce lateral wear to some extent, but on the other hand it causes other inconveniences and under these conditions is a remedy which perhaps has more drawbacks than advantages.

Mr. Ripert (in French). — It is used above all on bridges; always for safety reasons. Many mountain lines do not have check-rails although they are very sinuous.

Consequently, the check-rail cannot be considered to be a very widely used method of preventing wear.

The President (in French). — In fact, it appears from the discussion and from the replies received by the two reporters that in principle the check-rail should be given up.

Mr. Ripert (in French). — It should not be generally used to prevent wear chamfering the rails.

The President (in French). — Yes, it is certainly effective, but it is unnecessary, even from the safety point of view, since there is no danger even if the section is reduced by one half.

Mr. Ripert (in French). — If a pair of wheels gets derailed, the inside check-rail certainly plays a part in the safety, quite apart from questions of wear.

The President (in French). — All the same it does not seem to be very useful.

To sum up, in the case of Summary 7 we can suppress the paragraph : « laying a check-rail alongside the inner line of rails ».

In Summary 9 we will say : « A check-rail is sometimes laid along the inner line on certain particularly sharp curves for safety reasons ».

Mr. Devouge, *French Equitorial Africa and the Camerouns* (in French). — Perhaps this should come right at the end of the Summary, before point 11 as the final remark, and suppress Summary 9.

The President (in French). — Certainly, if everyone agrees.

Mr. Venkataramayya. — I do not know. In India at least the check-rail has been laid to reduce the wear of outer rails. On some railways the distance between the check-rail and the rail has been so adjusted that it does check the wear on the outer rail, and does reduce wear on the rail. It has been specially put in for that purpose.

You can modify Summary 9, but I do not think it is advisable to delete it altogether from Summary 7.

The President (in French). — To meet the wishes of our English colleagues, we will retain paragraph 7 as approved just now, and in paragraph 9 we will say :

In the first sentence :

« A check-rail is sometimes laid alongside the inner line... but it appears, essentially, for safety reasons » or « ... most often for safety reasons ».

and in the second sentence :

« The check-rail on the other hand has certain drawbacks as regards the maintenance of the track, sometimes causes additional wear, etc. ».

Mr. Venkataramayya. — Inner rail or inner line? I think inner rail is better.

The President. — Agreed.

Mr. Venkataramayya. — « This seems to be essentially a safety measure », in place of that we can say « certain particularly sharp curves to increase the safety ».

The President. — We will say therefore : « A check-rail is sometimes laid along the inner line on certain particularly sharp curves, for safety reasons ». *(Agreed.)*

Mr. Venkataramayya. — In the second sentence « The check-rail has, *however*, the drawbacks » instead of saying « The check-rail has, *in fact*, the drawbacks ».

— The text adopted for Summary 9 is as follows :

« 9. A check-rail is sometimes laid

along the inner rail of certain particularly sharp curves to increase safety. The check-rail has, however, the drawbacks of causing supplementary wear on the inner surface of tyres and increasing the resistance to movement. »

The President (in French). — Gentlemen, I suggest we now adjourn the Meeting as Mr. RIPERT has to attend the Special Commission for revising the Rules and Regulations. We will resume our discussions to-morrow morning at 9 o'clock.

— The meeting adjourned at 11 a.

Meeting held on the 21st May 1954.

PRESIDENT : W.A. VRIELYNCK.

— The meeting began at 9.15 a.m.

The President (in French). — Gentlemen, we will continue our work by examining Summary 10.

Mr. Ripert. — *Summary 10 :*

10. Rails of steel with a high degree of resistance to wear are used by some Railways in low radius curves of lines with heavy traffic : naturally-hard rails of a single grade of steel usually manganese — composite steel rails in which only the portion of the head subject to wear is of hard steel — heat-treated rails (sorbitic or martensitic).

These rails give a greatly increased life, 2 to 5 times that of ordinary quality steel. Their higher price, however, often prevents their use being extended.

The President (in French). — Has anyone any comments to make about this subject?

Mr. Schäder, *Swedish State Railways.* — In his report Mr. RIPERT says that the life of steel rails with manganese content of about 1.5 % may be five times as much as that of ordinary quality steel. The Swedish State Railways have used such rails on sharp curves for many years and their experience is that the rails have a high resistance to wear but unfortunately, during severe winters, they are subject to more breakages than ordinary rails. I can mention as an example that during one cold winter we had about eight broken rails per 100 km (manganese rails) compared with about four broken rails per 100 km (ordinary rails).

I therefore propose a slight modification of the last sentence of this Summary as follows :

« Their higher price and in some cases greater brittleness at low temperatures, however, often prevent their use being extended. »

Mr. Broca (in French). — It is not only a question of low temperatures; the French Railways have had a lot of trouble, especially in the case of heat treated rails; there has been many fractures, not only in cold weather and we have found flaws and fractures throughout the year.

The phenomenon of flaking must also be mentioned which may make it more troublesome to use such rails.

The President (in French). — If this is so, I think the word « brittleness » will do very well. It is a fairly general expression and will cover not only fractures at low temperatures but also flaking. I suggest therefore that we say :

« Their brittleness, especially at low temperatures, often prevents their use. »

Have the Swedish Railways any experience of composite rails?

Mr. Schäder. — No, we have not.

The President (in French). — And in tropical regions, in the Congo for example, Mr. RICHELOT, have you any experience?

Mr. Richelot (in French). — Up to the present, we have used rails of ordinary steel and we have had a lot of wear on curves; we have however on order some heat treated rims (bourrelets), but have no experience of them yet.

The President (in French). — And on the Lower Congo to Katanga Railway?

Mr. De Busschere, *Lower Congo to Katanga Railway* (in French). — No, Mr. President.

The President (in French). — In the French Colonies?

A Delegate (in French). — No experience.

The President (in French). — Perhaps, it is the high cost which prevents their use?

A Delegate (in French). — Yes.

The President (in French). — Under these conditions, we can retain the Summary with the modification suggested.

Mr. Klaren *(Office de Recherches et d'Essais de l'Union Internationale des Chemins de fer)*. — I should like to draw your attention to one point about the price of manganese steel. I know that the experience of the Netherlands Railways, for instance, is that a steel with a low content of manganese is not so high as to prevent the use of it. The Netherlands Railways are of the opinion that only a steel with a high content of manganese, for instance for points and crossings which has a very high content of manganese, sometimes prevents their use for economic reasons. But steels with a low content of manganese are readily used in the Netherlands Railways because their price gives no objection. The lifetime of such rails is a more important item, so perhaps in the Summary there can be...

The President. — Is this always true in the case of curves? Do you use this steel on curves?

Mr. Klaren. — No, only for points and crossings we use steel with a high content of manganese which is very expensive, but steel with a low content of manganese is not so expensive as to prevent its use in curves.

The President. — And you have steel in the Netherlands with a low content of manganese?

Mr. Klaren. — Here and there we use it, and we have no objection to the cost of it. So perhaps in the Summary there could be a slight modification to say that only with a rather high content of manganese the cost sometimes prevents its use.

Mr. Ripert. — I think it would be useful to state the content. I think it is a question of Siemens-Martin rails with a content of 1.45 % manganese and a tensile strength of 90 kg.

Mr. Klaren. — Yes.

The President (in French). — We will therefore say :

« But the high cost of rails with a high proportion of manganese and their brittleness, particularly at low temperatures, often prevents their use. »

Does everyone agree to this text?

Mr. Venkataramayya. — This brittleness is not only of the high manganese rails but also of the heat-treated rails. So if you mention the high price of high manganese rails it might mean *only* high manganese rails.

Mr. Broca. — But it says so in the text.

Mr. Venkataramayya. — Yes, but the brittleness is not only of the high manganese rails.

The President (in French). — I understand the distinction you wish to make, Mr. VENKATARAMAYYA, in the case of heat treated rails. Perhaps we might say : « but the high cost of rails with a high manganese content, as well as... ».

Mr. Meunier (in French). — We should speak of all rails of special composition and add :

« However rails with a low manganese content are not prohibitive in price and could be used. »

The President (in French). — Under these conditions, suppose we added at the end :

« However rails in steel with a low manganese content do not have this drawback, at least from the point of view of price. »

Mr. Richelot (in French). — Nor heat treated rails; they are not expensive. It is the rails with a high manganese content that are dear.

The President (in French). — « It should however be noted that rails with a low manganese content and heat treated rails are not prohibitive in cost. »

Mr. Ripert (in French). — Rails with a low manganese content are no longer resistant to wear; they are ordinary rails, as there is always some manganese in the rails.

The President (in French). — I do not think however there would be any inconvenience in saying so in the Summary.

Mr. Ripert (in French). — It is just a shade different in meaning.

The President (in French). — « Heat treated rails and those with a low manganese content are not however prohibitive in price. »

Mr. Broca (in French). — We might turn it round and say : « their brittleness often prevents to develop their use » and mention « Rails with a high manganese content are however too dear ».

Mr. Ripert (in French). — As well as bi-metallic rails.

Mr. Broca (in French). — Brittleness is a general fact; the others are special facts; the sentence could be divided up.

The President (in French). — We might come to this conclusion : delete the last sentence and say :

« Their brittleness, especially at low temperatures, often prevents their use. Rails with a high manganese content and bi-metallic rails are however very expensive. »

Mr. Renard, *Railways Economiques de Liège-Seraing et Extensions* (in French). — Is brittleness specified for all the kinds of rails or only for high manganese content rails in particular?

Mr. Broca (in French). — I do not know if brittleness has been reported in the case of bi-metallic rails?

The President (in French). — Has anyone here present any experience of brittleness in the case of bi-metallic rails?

Apparently not.

Mr. Mohr, *Rhaetian Railways, Switzerland* (in French). — We have some bi-metallic rails (Verbundstahl) which have already been in use for 20 years. They are the best rails we know; we get temperatures of as much as 20 and 25 degrees below zero, and have not experienced any disadvantages.

The President (in French). — This then is the answer to Mr. Renard's comment that brittleness only applies to rails with a high manganese content and heat treated rails.

Mr. Mohr (in French). — We could keep the sentence you suggested just now, namely that the cost of rails with a high manganese content as well as their brittleness in cold weather limits their use.

The President (in French). — We will therefore say : « These rails give a greatly increased life (2 to 5 times that of ordinary quality steel). The high cost of rails with a high manganese content and heat treated rails... »

Mr. Broca (in French). — No, the latter are not particularly dear.

The President (in French). — But you have found that heat treated rails are brittle?

Mr. Broca (in French). — Yes, they have had to be taken out on main lines.

The President (in French). — I suggest saying : « The high cost of rails with a high manganese content, the brittleness of these rails and of heat treated rails, especially in low temperatures, prevents them being used ».

I think this will satisfy everyone?

— *The final text will be submitted when the Summaries are read at the end of the discussions.*

Mr. Ripert (in French). — Before I read Summary 11, I would like to remind you of the different methods of lubricating rails.

The reduction of the friction between the surfaces in contact is the most rational method and the most effective in reducing wear.

The principal types of lubricators can be grouped into two categories :

— those fastened to the rail at the entrance to a curve, worked by the passage of each wheel;

— those fitted to motor units.

1) The first include the following types :

— P & M, equipment which emits *hard grease* which is picked up by each wheel flange;

— « *Aladdin* », equipment which also emits *hard grease* under the effect of the vibrations of the rail;

— *Racoor 4 000* equipment, which has a much larger capacity container than the above equipments;

— *Paehler* equipment which lubricates directly the head of the rail by emitting oil whenever a wheel passes over it.

2) Lubricators mounted on motive power units can be grouped into two sub-categories :

— those which lubricate the flanges;

— those which lubricate directly the inner face of the head of the outer rail.

a) Flange lubricators have the following components for lubricating :

— either an oil impregnated wick;

— or a roller running round the edge of the flange formed of leather discs through which the oil oozes;

— or a steel needle valve, case hardened and heat treated, or a hard wood pencil;

— or an air or steam ejector.

Some of them work all the time, both on the straight and on curves (Bertschmann, Buclon, pointeau Friedmann, Charmilles lubricator...).

Others work automatically on the flange corresponding to the greater radius. Such as the De Limon Fluhme equipment (Deutsche Bundesbahn) and that designed by Dr. Tonni (recently introduced on the Italian Railways).

b) The other sub-category of lubricators mounted on motive power units covers equipment which *directly lubricate the rail*, by means of a vaporisor or ejector which emits an emulsion of air and oil. Such equipment is worked by compressed air produced on the machine and works automatically on curves of a given radius, by means of the displacement of the bogie in relation to the main frame (Lubrovia apparatus, Riboulet apparatus, equipment mounted on trailers of the R.A.T.P.).

The President (in French).— Mr. RIPERT has given us a résumé of his report in order that Summary 11 will be more readily understandable. We think in fact that this is one of the most interesting Summaries, lubricating being in the opinion of those Railways who replied the most effective method of overcoming wear of the rails on curves.

Mr. Ripert (in French). — Here is the text of *Summary 11 :*

11. Lubrication of the inner face of the head on the outer line of rail is at present used by numerous Railways.

Manual lubrication, limited to special case because of the labour cost involved, must be carefully done to avoid the spread of oil on to the running surface.

Several types of fixed lubricators and equipment mounted on motive units or trailer vehicles provide a satisfactory regularity of operation.

The use of lubricators fixed to the rail at the entrance to curves, worked by the passage of each wheel, is particularly justified on isolated curves of low radius, or where the curves are relatively few in number.

Equipment fitted to motive units or trailer vehicles, either lubricating the rails directly or the wheel tyres, are more economical than the above on lines which include fairly numerous curves. This lubrication can be continuous on very sinuous lines, but is usually automatically restricted to the entrance to low radius curves.

Rail lubrication provides a very efficient means of reducing not only their lateral wear, but also tyre wear. The life of rails is, in certain cases, almost doubled.

The President (in French). — I do not think there will be many comments about this Summary; however if any one of you has any interesting experience...

Mr. Pialoux (in French). — At the end of this Summary it says : « The life of rails is in certain cases almost doubled ». Do the results of the enquiry make it possible to give any approximate figures for the increase in the life of the tyres?

Mr. Ripert (in French). — As far as the wear of the tyres is concerned, the effectiveness of lubrication is still greater than for the reduction in the lateral wear of the rails, since the wear of the tyres shows much more quickly.

One must in fact take into account the relationship between the number of impacts suffered by each point of a tyre and that suffered by each point of a rail. It is obvious that the tyre will receive a great many more, even on lines with heavy traffic.

The President (in French). — It is very difficult to give any figures.

Mr. Pialoux (in French). — Our reply gave some figures; they were very important. It is an interesting Summary, but the figures must be coordinated. It depends upon the sinuosity of the railway.

The President (in French). — Under these conditions, it is rather difficult to give an accurate figure. But I am sure that lubrication is of still greater value in the case of the tyres than in the case of the rail.

Mr. Ripert (in French). — A wheel of 1 m diameter turns about 300 times per km, and if it runs 100 km a day each point of the tyre receive 30 000 impacts per day, whereas a rail on a line with little traffic will receive a number of impacts 100 to 300 times smaller.

Mr. Pialoux (in French). — In fact the tyres are renewed every year or every two years, whilst the rails have to be renewed every 50 years.

Mr. Ripert (in French). — From the information supplied by several Railways, the periodicity of the reprofiling of the tyres may be 2 to 6 times greater, with lubrication.

The President (in French). — This is outside the question, but not without interest. What mileage do the tyres generally last? What is the ratio between the life of a non-lubricated tyre and one that has been lubricated? Have you any figures, Mr. PIALOUX?

Mr. Pialoux (in French). — We have no figures, we have only just ordered some lubricators.

The President (in French). — Can any one give any information on this point?

Mr. Meunier (in French). — We use lubricators, but no figures are available as yet. It is easy to judge of the improvement in the life of the tyres as these have to be renewed so often; in the case of the rails, longer experience is needed. We have used lubricators for about two years.

The President (in French). — Experience does not cover the renewal of rails, but only measurements made of the wear of rails.

Mr. Masseron, *Compagnie Fermière des Chemins de fer Tunisiens* (in French). — We have lubricated the rails for 20 years on metric gauge on curves of small radius. Before, it was necessary to replace the rails every 5 years; towards 1936-37, we began to lubricate, and the life of the rails went up from 5 to 10 years at least.

The lubrication is done by means of equipment mounted on the engine and working on curves of less than 250 m radius.

The President (in French). — So your experience is fairly long?

Mr. Masseron (in French). — Yes, and it can be affirmed that lubrication on curves of small radius doubles the life of the rails.

Mr. Broca (in French). — Precise figures are given in the report; Mr. RIPERT gives 25 % for the Belgian Railways, 40 % for the Netherlands Railways and 50 % for the Tunisian Railways.

The President (in French). — The differences are probably due to the different length of time lubricators have been in use.

Mr. Masseron (in French). — It depends on the radii, on curves of small radius, the life of the rails is doubled.

The President (in French). — We are now talking of rails, but the value of lubricators is still greater in the case of the tyres.

All this exchange of views is most interesting. It does not in any way alter the Summary in its present form, and we will merely retain the following; in the end lubricators will be in general use wherever there are numerous curves, and their value will lie not only in increasing the life of the rail, but also the life of the tyres.

Mr. Ripert (in French). — We said « The life of the rails is in certain cases almost doubled ». We could even go further than this.

The President (in French). — According to the reports, certain Railways stipulate automatic lubrication.

Mr. Masseron (in French). — Manual lubrication gives poor results, lubrication must be done up to a radius of about 300 m.

Mr. Meunier (in French). — This confirms what I said yesterday, that the 300 m radius is not bad. Moreover it is only since we went in for Diesel engines that we found any marked wear in curves of less than 300 m.

Mr. Richelot (in French). — It is the same on our Railway; we had steam locomotives fitted with lubricators and we have not had to reverse the rails on curves of 150 m radius for more than 20 years.

For the last three years, we have had some Diesel locomotives and the wear has increased, and on all curves of 150 to 250 m radius the rails have had to be reversed. But the Diesel locomotives are not fitted with lubricators, because we hoped that these bogie Diesel locomotives would have a less harmful effect upon the track than the wide wheelbase steam locomotives; the track does not stand up any better to the Diesel locomotives.

We are now fitting Lubrovia lubricators. And we have to retread the tyres every 18 000 km with the Diesel locomotives, whereas with the steam locomotives this was only necessary every 80 000 km.

The President (in French). — What is the load for the steam and the Diesel locomotives?

Mr. Richelot (in French). — Practically the same : 15 metric tons for the Diesels and 16 metric tons for the steam locomotives. The greater part of our track is still laid with 33 kg rails, but we are gradually replacing these with 40 kg rails.

The President (in French). — All this information is extremely interesting but it does not alter the Summary in any way.

Should anything be added to the Summary? It is somewhat outside the question, but it is a very interesting subject for a great many of us.

Mr. Masseron (in French). — A propos the types of lubricators, we have some P & M equipment on standard gauge lines which gave us some trouble at the beginning when they were first installed as the electro-magnetic brakes hit up against the piston heads. We reported the problem to the U.I.C. as the running gauge and the gauge of the track play a part in this. We have, for the time being, altered the lubricators but this shows that the problem of the fixing of the clearance gauge for the low parts of locomotives must be solved from the international point of view.

I think this question comes within the scope of our discussions.

After the paragraph : « The use of fixed lubricators... are relatively few in number » I would like to add : « These lubricators must clear the electro-magnetic brakes, so that the clearance of the latter should be defined ». This because it has never been specified so far.

The President (in French). — This relates to lubricators fixed to the rails. But is there not a tendency to give up lubricators fixed to the rails?

Mr. Masseron (in French). — On our standard gauge lines, there are not sufficient curves to justify installing lubricators on the locomotives : it is also certainly the case for other Railways.

Therefore, attention must be drawn to the gauge, which is a very important point, by saying : « These lubricators must clear the electro-magnetic brakes, so that the clearance of the latter should be defined ».

If this were done, the makers could conform to this clearance. We wrote to the U.I.C. about this, but we did not get any reply.

The President (in French). — These electro-magnetic brakes are only used on the electrified lines?

Mr. Masseron (in French). — And also on our Diesels.

Mr. Ripert (in French). — Rather than defining the clearances, would it not be better to say :

« The lubricators should be designed with the necessary clearance in view »?

Mr. Masseron (in French). The clearance for the rolling stock between two wheels is not laid down.

The President (in French). — Or : « Lubricators should be so designed as to clear the rolling stock gauge ».

Mr. Masseron (in French). — There is no such gauge.

Mr. Richelot (in French). — There is a transversal gauge giving the available height, but no longitudinal gauge, and there is a risk of getting parts which hit.

The President (in French). — We might leave the Summary as it is and present this point in the form of a recommendation.

Mr. Venkataramayya. — This braking equipment may be special for this Railway, but we don't have any difficulty in India. Is it necessary to mention this particular difficulty about equipment? This Summary gives in general how oil lubricators are fitted and so on — is it necessary to include this addition?

The President (in French). — It is only a recommendation. Do you use such lubricators fixed to the rails?

Mr. Venkataramayya. — We do.

The President. — Do you use electro-magnetic brakes? *(No)* Then, I suppose we could retain this addition.

Mr. Venkataramayya. — No objection.

Mr. Meunier (in French). — Could we not say: « Precautions should be taken... »

Mr. Masseron (in French). — It should be pointed out that if there is an ommission in the international gauges, it would be a good thing to have this point defined.

The President (in French). — Mr. MASSERON is right.

— *Summary 11 was adopted in the following form :*

« 11. Lubrication of the inner face of the head on the outer line of rail is at present used by numerous Railways.

« Manual lubrication, limited to special cases because of the labour cost involved, must be carefully done to avoid the spread of oil on to the running surface.

« Several types of fixed lubricators and equipment mounted on motive units or trailer vehicles provide a satisfactory regularity of operation.

« The use of lubricators fixed to the rail at the entrance to curves, worked by the passage of each wheel, is particularly justified on isolated curves of low radius, or where the curves are relatively few in number.

« These lubrificators having to clear the gauge of the electro-magnetic brakes, it follows that it would be useful to have this gauge defined.

« Equipment fitted to motive units or trailer vehicles, either lubricating the rails directly or the wheel tyres, are more economical than the above on lines which include fairly numerous curves. This lubrication can be continuous on very sinuous lines, but is usually automatically restricted to the entrance to low radius curves.

« Rail lubrication provides a very efficient means of reducing not only their lateral wear, but also tyre wear. The life of rails is, in certain cases, almost doubled. »

The President (in French). — As we have now completed our examination of the Summaries, we are going to read them through a second time to make sure the text is absolutely correct.

At our meeting yesterday we adopted *Summary 1* as originally worded. *Summary 2* was slightly modified in the case of the second paragraph.

Summaries 3 and 4 were adopted without modification. As regards *Summary 5*, Mr. MEUNIER has a comment to make.

Mr. Meunier (in French). — I am wondering if the formulae $\frac{K}{R}$ and $\frac{K}{R^2}$ are accurate; have they been confirmed by experience?

The President (in French). — Do you consider these formulae too rigid?

Mr. Meunier (in French). — It is already very vague, but in fact the upper and lower limits are not at all certain.

The President (in French). — We might say : « ... in a varying proportion which certain consider to be $\frac{K}{R}$ and others $\frac{K}{R^2}$ ».

Mr. Klaren (in French). — Could we not say : « ... in a proportion which probably lies between... »

Mr. Meunier (in French). — « Which seems to lie between... » This is a good idea, as there is no basis, no calculations, no experience available.

The President (in French). — We might say : « ... in a proportion which seems to lie between $\frac{K}{R}$ and $\frac{K}{R^2}$ ».

(Agreed.)

On the other hand, the last sentence has been modified as follows : « the angle of thrust of the axles » so that the final text reads :

« 5. As the factors which influence the wear of rails in curves are numerous, it is difficult to separate any one of them from the whole. The quality of maintenance must also be taken into account.

« It is generally admitted that the lateral wear of the outer rail in a curve of radius R increases as a function of :

« — the curvature in a proportion which seems to lie between $\frac{K}{R}$ and $\frac{K}{R^2}$;

« — the axle load and the speed of the operation;

« — the angle of thrust of the axles. » *(Agreed.)*

Summary 6 was adopted without change.

Summary 7 was discussed at length at yesterday's meeting. I would remind you that we decided to suppress the paragraph — « laying a check-rail alongside the inner line of rails ».

Does everyone agree to the amended text?

Mr. Masseron (in French). — We would like to know if anyone has any experience of reversing the rails. It says in the last paragraph of this Summary : « ... by reversing the rails end to end ».

The moment of inertia of a reversed rail is reduced, just when a larger moment of inertia is required. The worn rail can be replaced or it can be laid in a siding, but reversing it end to end does not seem advisable. I would therefore like to know if any Railway has any experience of this.

Mr. Ripert (in French). — I mentioned the example of the Swiss Federal Railways who allow wear in the form of a gendarme's hat to an extremely pronounced extent, especially on the St. Gothard line which can be considered an extremely interesting experimental field, as on that line there are many curves of 300 m radius.

Mr. Mohr (in French). — On our lines, we change the rails over from one side to the other.

The President (in French). — However from the information Mr. RIPERT received, it appears that the rails are reversed end to end. Or are both methods practised?

Mr. Mohr (in French). — Yes, but as a general rule the rails are removed from curves and relaid in straight sections.

Mr. Ripert (in French). — Reversing end to end is often difficult on account of the site, on the other hand, changing the two lines of rails over may present difficulties owing to differences in the lengths.

Mr. Masseron (in French). — We use them in sidings.

The President (in French). — However, I think the Summary can remain as it is, as it says : « ... on several Railways ». This does not mean that some Railways may think it is not very interesting to do so, it is a simple statement of fact.

Perhaps, if you like, we could add that reversing end to end does not appear of much value.

Do you agree that we should add that reversing end to end is not of great value?

Mr. Ripert (in French). — I would suggest putting this addition at the end of Summary 7.

Mr. Masseron (in French). — Reversing end to end reduces the inertia of the rail however.

Mr. Ripert (in French). — So does changing them over to the other line of rail.

Mr. Broca (in French). — We might say : « Reversing end to end, however, tends to reduce the inertia of the rail ».

The President (in French). — I think it would be better just to add : « It appears that reversing the rails end to end is of least interest... » *(Agreed.)*

The final text of Summary 7 will therefore be :

« 7. To combat wear of rails in curves, the following methods are adopted :

« — alteration of widening of the gauge, and modification of the superelevation;

« — use of rails with a high resistance to wear;

« — lubrication of rails.

« On several Railways, the life of rails is extended where one lateral face of the head is worn by reversing them end to end, by changing them over to the other line of rail, or by relaying them in tracks of less importance.

« It appears that reversing the rails end to end is of least interest.

— *Adopted.*

The President (in French). — *Summary 8* was adopted in its original form.

Summary 9 was also approved, but with a slight amendment to the original text.

This brings us to *Summary 10*, the second paragraph of which was modified. I will recall the text agreed in principle for this modification :

« The high cost of rails with a high manganese content, the brittleness of such rails, as well as that of heat treated rails, especially at low temperatures, prevent their use. »

I think it would be better to say at the end « ... limit their use ».

Mr. Ripert (in French). — The high cost of bi-metallic rails should also be mentioned.

The President (in French). — On the other hand, it is considered that heat treated rails are not particularly dear. We will therefore say : « The higher price of rails with a high manganese content and of bi-metallic rails, their brittleness...»

It appears that no one has any experience as far as the brittleness of bi-metallic rails is concerned.

Mr. Ripert (in French). — The Rhaetian Railway is satisfied of their use. The Italian Railways are of the opinion that the value of bi-metallic rails is that this prevents cracks spreading. If a crack occurs, it is limited owing to the heterogenity of the rail.

The President (in French). — I think we might say : « The higher price of rails with a high manganese content and of bi-metallic rails, the brittleness of the former, particularly at low temperatures, together with heat treated rails, however, prevent their use being extended ».

I am wondering however if the brittleness of heat treated rails was reported?

Mr. Ripert (in French). — Yes, this was reported, especially in connection with the risk of flaking.

Some Railways limit heat treatment to the ends of the rails. I believe this is so on the S.N.C.B.

The President (in French). — The final text of Summary 10 will therefore read :

« 10. Rails of steel with a high degree of resistance to wear are used by some Railways in low radius curves of lines with heavy traffic : naturally-hard rails of a single grade of steel usually manganese — composite steel rails in which only the portion of the head subject to wear is of hard steel — heat-treated rails (sorbitic or martensitic).

« These rails give a greatly increased life, 2 to 5 times that of ordinary quality steel.

« The higher price of rails with a high proportion of manganese and of bi-metallic rails, the brittleness of the former particularly in low temperatures, together with heat-treated rails, however, prevent their use being extended. »

(Adopted.)

In *Summary 11* we made the following addition :

« These lubricators having to clear the gauge of the electro-magnetic brakes, it follows that it would be useful to have this gauge defined. »

Mr. Hirzel, *Federal Transport Office, Switzerland* (in French). — I would like to go back to the question of gauge widening. The *Rhaetian Railway*, in Switzerland, has done away with gauge widening completely, so that there is none, even on curves of 100 m radius, where the gauge is 1 000 mm and no more. On curves of less than 100 m, there is a reduced gauge widening.

Very satisfactory trials were carried out with a test train consisting of six and eight wheeled locomotives, and four and six wheeled service wagons. On the Rhaetian Railway, we have a trial curve of 150 m radius, which is nearly 180°; on half of it there is gauge widening, on the other half none, and it has been found that there is no difference in the wear.

The President (in French). — What are the speeds?

Mr. Hirzel (in French). — The speed depends of the radius and varies between 30 and 55 km/h.

Mr. Masseron (in French). — What is the weight per axle?

Mr. Hirzel (in French). — The weight per axle is 11 to 12 metric tons.

Mr. Bosc, *Madagascar Railways* (in French). — And what tyre wear do you get?

Mr. Hirzel (in French) .— There is no wear. Are there any delegates present representing Railways where gauge widening has been completely given up?

Personally, I am representing the Swiss Government; we have recommended other private Railways to suppress gauge widening; they have followed our advice but we have not heard the results yet. It is obvious that trials must be carried out before doing away with gauge widening.

The President (in French). — In Switzerland, therefore, gauge widening is being done away with, even when the speeds are fairly high?

Mr. Hirzel (in French). — The maximum speed is 55 km on narrow gauge curves, in view of the fact that on curves of 100 m it is impossible to exceed 42 km with a superelevation of 10 cm.

Mr. Rousset, *Franco-Ethiopian Djibouti to Addis-Ababa Railway.* — Is the section of the tyre the same as the standard section of the Swiss Railways?

Mr. Hirzel (in French). — The tyres on the Rhaetian Railway (narrow gauge) differ from those of the Swiss Federal Railways (standard gauge).

Mr. Masseron (in French). — How many trains a day?

Mr. Hirzel (in French). — 20-70 trains per day according to the line.

Mr. Rousset (in French). — Could you tell us the gauge of the inside face of the tyres as well?

Mr. Hirzel (in French). — The play between the new tyre and the new railhead is 3 mm.

Mr. Bosc (in French). — I would like to mention a trial made on the Congo-Ocean Railway on curves of 100 m radius.

When the Congo-Ocean was built, with 30 kg rails, and in some places curves of 100 m, gauge widening was suppressed, or at least kept within very small limits. The locomotives were fairly heavy and ran at about 50 km/h, except for the increased speed down the Mayumbe gradient; after 15 years the rails had to be replaced.

The President (in French). — And now you use gauge widening?

Mr. Bosc (in French). — Yes.

The President (in French). — Are the wheelbases the same?

Mr. Bosc (in French). — There is some new bogie stock; as regards the wheelbases, there are *Mikados* with 4 m between the end pairs of wheels and four coupled axles.

Mr. Richelot (in French). — It seems that when there is a changeover from steam to Diesel or electric traction, then is the time to tighten up the track. This means that in the case of Mikado locomotives, gauge widening is necessary, or else there is too much play between the tyres and the rails on the straight; so that in practice gauge widening is necessary.

In the case of bogie locomotives, the problem is different, as in this case the bogie wheelbase is smaller, and to prevent too sharp an angle of thrust, the track must be tightened up to the limits allowable for steam locomotives.

The difficulty is on Railways where both steam and Diesel tractions are used; the steam locomotive with its wide wheelbase requires gauge widening, but the Diesel does not.

Mr. Segretain, *Compagnie des Phosphates et du Chemin de fer de Gafsa, Tunisie* (in French). — We have operated with steam traction (Decapod locomotives) mountain lines with a certain amount of gauge widening and this was not altered when we changed over to Diesel traction, exclusively, with two axle-bogie locomotives, but we did not experience any additional wear.

Mr. Richelot (in French). — Are there some curves?

Mr. Segretain (in French). — Yes; 250 m.

Mr. Bosc (in French). — I would like to add that on the Congo-Ocean, after the rails were replaced, the gauge widening was increased, and very heavy Diesel-electric locomotives were put into service, the axle load of some being 16 metric tons, and the gauge widening was retained.

Mr. Rousset (in French). — May I insist upon the question of the distance between the wheels; in fact we carried out trials and our tyres were effectively closer together than usual, and this is probably why the absence of gauge widening is more readily admissible on the Rhaetian Railway.

The President (in French). — Gentlemen, this exchange of opinions on gauge widening has been of great interest to everyone; I think however that the points raised do not involve any alteration of Summary 8 as adopted. *(Agreed.)*

I thank you all for your kind attention, and in particular I wish to thank all those who took part in the discussions. We will meet again on Monday May 24th to continue our work.

— The meeting adjourned at 11 a.m.

DISCUSSION AT THE PLENARY MEETING.

Meeting held on the 25th May 1954.

PRESIDENT : SIR BRIAN ROBERTSON.
GENERAL SECRETARIES : MESSRS. P. GHILAIN AND C. E. WHITWORTH.

Mr. Ghilain, *General Secretary* (in French). — We now come to the examination of the Summaries for Question 10, the text of which was published in Nos. 2 and 3 of the Congress Daily Journal.

Mr. Ghilain then read these Summaries which did not lead to any comment.

The President. — We will therefore consider the Summaries for Question 10 as ratified.

SUMMARIES.

« 1. The characteristic form of wear on « a rail of the outer line of curved « track is a chamfering of the inner « face of the head, the angle of which « varies between about 20° to 30° to the « centre of the rail. In addition, the « running surface is worn on a plane « sometimes slightly inclined towards the « centre of the track.

« The inner line of rail is subject to « vertical wear of the running surface, on « a plane almost parallel to it.

« The finish of surface is usually main« tained. Binding is sometimes expe« rienced, accompanied by the shedding « of flakes of metal.

« 2. The characteristics of track laying « considered to have the greatest influence « on wear of rails on curve are :

« — curvature of the track; lateral wear « being appreciable in curves with radii « of less than 600 m (656 yards) standard « gauge and 350 m (383 yards) metre « gauge with fairly important traffic;

« — insufficient superelevation with « lateral wear of the outer rail; excessive « superelevation for vertical wear of the « inner rail;

« — steep down gradients;

« — excessive widening of the gauge;

« — insufficiently long parabolic curves.

« 3. The features of rolling stock which « have a predominant influence on the « wear of curved rails are principally « those which affect the angle of thrust « of the wheel on the rail; long rigid « wheelbase, or on the contrary an « insufficiently long wheelbase, total play « of the axle in the track, longitudinal or « lateral play of the axleboxes, lateral « play of journals.

« Amongst other causes of wear may be « mentioned : the stiffness of some bogie « or bissel side control arrangements, « amount of unsprung masses, diameter « of wheels. Small diameter wheels cause « higher stresses and heavier hammer-

« blows at rail gaps than wheels of large « diameter.

« 4. The effects of locomotives and « motor coaches with driving bogies are « the object of varying views. Whilst « some Administrations have not noticed « any harmful results, others consider « them to be particularly aggressive and « to produce lateral rail wear which is « much heavier than that caused by « carrying bogies or by certain long « wheelbase vehicles.

« These effects are attributed prin- « cipally :

« — to the amount of the axle load « and especially to the unsprung mass « (particularly of nose-suspended trac- « tion motors);

« — to the increased rate of accelera- « tion and speed;

« — to asymmetrical motor couple.

« They show themselves particularly in « track irregularities.

« 5. As the factors which influence the « wear of rails in curves are numerous, « it is difficult to separate any one of « them from the whole. The quality of « maintenance must also be taken into « account.

« It is generally admitted that the lateral « wear of the outer rail in a curve of « radius R increases as a function of :

« the curvature, in a proportion which « appears to be between $\frac{K}{R}$ and $\frac{K}{R^2}$;

« the axle load and the speed of oper- « ation;

« the angle of thrust of the axles.

« 6. The limits of lateral wear and that « on the running surface have been esta- « blished on the basis of experience, « taking into account the reduced strength « of the rail.

« It is only in exceptional cases that « chamfering of the worn head of the « outer rail has been admitted as a « decisive factor in derailments caused by « the flange mounting the rail.

« 7. To combat wear of rails in curves, « the following methods are adopted :

« — alteration of widening of the « gauge, and modification of the super- « elevation;

« — use of rails with a high resistance « to wear;

« — lubrication of rails.

« On several Railways, the life of rails « is extended where one lateral face of « the head is worn by reversing them end « to end, by changing them over to the « other line of rail, or by relaying them « in tracks of less importance.

« It appears that reversing the rails « end to end is of least interest.

« 8. The degree of gauge-widening given « to track has been reduced on some « lines, with the aim of lowering the angle « of thrust and reducing oscillation, as far « as compatible with the free inscription « of vehicles in the curve. Attempts have « been made to achieve a closer relation- « ship between superelevation and oper- « ating speeds.

« 9. A check-rail is sometimes laid along « the inner rail of certain particularly « sharp curves to increase safety. The « check-rail has, however, the drawbacks « of causing supplementary wear on the

« inner surface of tyres and increasing « the resistance to movement.

« 10. Rails of steel with a high degree « of resistance to wear are used by some « Railways in low radius curves of lines « with heavy traffic : naturally-hard rails « of a single grade of steel usually manganese — composite steel rails in which « only the portion of the head subject to « wear is of hard steel — heat-treated « rails (sorbitic or martensitic).

« These rails give a greatly increased « life, 2 to 5 times that of ordinary « quality steel.

« The higher price of rails with a high « proportion of manganese and of bimetallic rails, the brittleness of the « former particularly in low temperatures, « together with heat-treated rails, however, prevent their use being extended.

« 11. Lubrication of the inner face of « the head on the outer line of rail is at « present used by numerous Railways

« Manual lubrication, limited to special cases because of the labour cost « involved, must be carefully done to « avoid the spread of oil on to the running surface.

« Several types of fixed lubricators and « equipment mounted on motive units or « trailer vehicles provide a satisfactory « regularity of operation.

« The use of lubricators fixed to the « rail at the entrance to curves, worked « by the passage of each wheel, is particularly justified on isolated curves of low « radius, or where the curves are relatively few in number.

« These lubrificators having to clear « the gauge of the electro-magnetic brakes, « it follows that it would be useful to « have this gauge defined.

« Equipment fitted to motive units or « trailer vehicles, either lubricating the « rails directly or the wheel tyres, are « more economical than the above on « lines which include fairly numerous « curves. This lubrication can be continuous on very sinuous lines, but is « usually automatically restricted to the « entrance to low radius curves.

« Rail lubrication provides a very efficient means of reducing not only their « lateral wear, but also tyre wear. The « life of rails is, in certain cases, almost « doubled. »

[621 .33]

QUESTION 11.

Protection of overhead lines, substations, locomotives and motor coaches against accidents of electric nature (excess voltage, overloads, short circuits and lightning...).

Preliminary documents.

Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New-Zealand, Norway, Pakistan, South Africa, Sweden and the United Kindgdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by T. S. Pick, B. Sc. (Eng.), (See *Bulletin* for November 1953, p. 887 or separate issue No. 11.)

Report (Austria, Belgium and Colony, Bulgaria, Czechoslovakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia), by J.F.M. De Boeck. (See *Bulletin* for February 1954, p. 191, or separate issue No. 19.)

Special Report by, J.F.M. De Boeck. (See *Bulletin* for May 1954, p. 594.)

DISCUSSION BY THE SECTION.

Meeting held on the 24th May 1954.

President : W. A. Vrielynck.

— The meeting began at 9 a.m.

The President (in French). — Gentlemen, today we will deal with the second point on our programme, namely Question 11 : « Protection of overhead lines, substations, locomotives and motor coaches against accidents of electric nature (excess voltage, overloads, short circuits and lightning...) ».

I call upon Mr. De Boeck, the Special Reporter who will kindly read us the Summaries from his report dealing with the first chapter : *Protection of high tension distribution systems.*

Mr. De Boeck, *Special Reporter* (in French). — *Summaries 1 and 2 :*

Protection of high-tension distribution systems.

1. The relay types of current manufacture assure an acceptable protection.

2. *a*) The protection of each point of dis-

tribution, including traction substations, is recommended.

b) In order to obtain an adequate protection of the installations, the protection should include overcurrent relays. combined with earth fault relays; in this respect, relays of the differential type are not sufficient.

The President (in French). — I think the text of these summaries will be approved by the meeting.

— *Summaries 1 and 2 are adopted without discussion.*

The President (in French). — We now come to the Chapter : *Protection of static transformers.*

Mr. De Boeck (in French). — *Protection of static transformers. Summary 3 :*

3. The ideal protection against overloads and short circuits consists of a group of two devices which control the tripping of the primary circuit breaker :

a) by an instantaneous overcurrent element;

b) by a device which includes an element whose temperature would reproduce that of the hottest spot of the windings.

The President (in French). — With converter units, the protection of the transformers against overloads is usually assured *de facto* by the protective measures taken for the corresponding converter.

In fact, the transformers usually have a greater overload capacity. An instantaneous maximum voltage device will be sufficient in such a case.

Mr. De Boeck (in French). — Exactly. It is why I suggest to add that the transformers having greater overload capacity than the converters. the protection of the transformers against overloads is unnecessary.

The President (in French). — Personally, I would prefer to leave the summary as it is.

Mr. Pick, *London Transport Executive, Reporter.* — May we refer to Special Report, Chapter 2, 21 — *Overloads and Short circuits,* the last paragraph where we say that « direct overcurrent trips should be preferred to relays connected to current transformers ...» we in this country prefer the current transformers. I don't know whether Mr. De Boeck might like to comment on this matter. It is not mentioned in the summaries but I hoped that there would be more people here to pick up that point for me.

M. Walter, *French National Railways* (in French). — To make it quite clear that protection against overloads is obtained with difficulty in the case of transformers, I suggest adding the following text to Summary 3 :

« The protection against overloads of the converter units being difficult to obtain owing to the overload capacity of this equipment, is not essential, seeing that their use rarely exposes them to unexpected loads. »

The President (in French). — This was what Mr. De Boeck suggested saying when he pointed out that as the converter units have not the same overload capacity than the transformers, it is more or less superfluous to protect the transformers against overloads.

First of all, we thought the text could remain as it is, but as you are agreed on this point, we can perhaps include this addition, and therefore we will say at the end of Summary 3 :

« The protection against overloads of the converter units being such as to amply cover that of the transformers, it is possible to dispense with the protection of the transformers themselves. »

Mr. WALTER, in France, your transformers are nearly all in the D.C. substations. You have only one 50 cycle line, the Aix-les-Bains-Annecy line. The Valenciennes-Thionville line is not yet in service.

M. Walter (in French). — It will be in one month's time.

The President (in French). — Have you followed these trials?

Mr. Walter (in French). — I deal with the fixed installations; I am not a locomotive expert.

The President (in French). — Do you think the 50 cycle system is going to be extended?

Mr. Walter (in French). — It certainly will be in France; we find it has great advantages from the point of view of reducing costs due to fixed installations. For the fixed installations as a whole, the reduction in costs, according to the line, whether there are any tunnels or not, is one third to two fifths, i.e. a saving of 35 to 40 %.

As far as the engines are concerned — but this is not my department — the results are equally interesting.

The President (in French). — I must agree that great progress has been made in this direction. In the case of the Belgian Light Railways, we carried out trials with the 50 cycle system some 45 years ago — right at the beginning — and we had an enormous amount of trouble.

Mr. Walter (in French). — The first engines delivered for the Aix-Annecy line were engines with direct motor. We are soon going to have on the Valenciennes-Charleville line engines with converter group and engines with rectifiers.

The President (in French). — Which means that the substation is actually on the locomotive itself.

Mr. Walter (in French). — Yes, but this makes a much different engine, with possibilities much higher than those of direct motor locomotives, whether they are direct current or single phase.

The President (in French). — But all the same the cost is much higher than that of a D.C. locomotive?

Mr. Walter (in French). — No, it so happens that the prices are not very different.

Mr. De Boeck (in French). — May I ask if it was you who prepared the answers to the questionnaire sent in by the S.N.C.F.?

Mr. Walter (in French). — Yes, in the case of the chapter : Fixed installations, only.

Mr. De Boeck (in French). — I must thank you for your very cartesian replies. However, I would like to ask you one question : The French Railways no longer use maximum voltage time lag relays; you are satisfied with instantaneous acting elements. Is this practice also followed by the other traction undertakings in France?

Mr. Walter (in French). — I really don't know.

The President (in French). — Have you any other comments to make?

Mr. Walter (in French). — Yes, in the case of Summary 10, I suggest the following amendment in order to make it a little more precise : « For converters with several vacuum enclosures of relatively low unit power (glass jars of about 200 to 300 kW)... » and in the case of Summary 11*a*) I suggest we say : « For converters with higher unit powers... »

The President (in French). — We will go back to these suggestions when we examine the Summaries in question. I will however point out now that according to Mr. WALTER's suggestion, this would make 500 amps at 600 volts; we go up to 400 to 500 kilowatts in Belgium. What objection have you to adopting this protection for 500 kW? Doubtless it is merely a question of what is the practice on your Railway?

M. Walter (in French). — Yes, on suburban lines working on 750 volts.

The President (in French). — We are more or less in agreement, except that on the S.N.C.V. we go to about 500 kW instead of limiting it to 300. I think that in Summary 10 it would be better not to mention the power, but merely say : « For converters with several vacuum enclosures of *relatively low unit power...* »

To go back to Summary 3, the text in accordance with the addition suggested by Mr. WALTER will be amended as follows :

« 3. The ideal protection against overloads and short circuits consists of a group of two devices which control the tripping of the primary circuit breaker :

« *a)* by an instantaneous overcurrent element;

« *b)* by a device which includes an element whose temperature would produce *that of the hottest spot of the windings.*

« The protection against overloads of converter units being such as to amply cover that of transformers, it is possible to dispense with protection of transformers themselves. »

— *Adopted.*

The President (in French). — We will go on to the next summary.

Mr. De Boeck (in French). — *Summary 4 :*

4. Theoretically, it is the « thermal image » which assure the most adequate protection against excessive heating.

— *Adopted without discussion.*

Summary 5 :

5. Overcurrent time delay relays assure an acceptable protection for all practical

purposes. Thermal relays of this type do not present any marked advantage.

— *Adopted.*

Mr. De Boeck (in French). — *Summary 6 :*

6. For oil immersed transformers, the use of contact thermometers measuring the oil temperature or thermostats gives a supplementary protection.

— *This Summary also remains unaltered.*

Summary 7 :

7. No H.T. surge arrestor offers a completely reliable protection. Their installation is not indispensable, especially when other devices *ad hoc* exist (earth wire on overhead distribution lines, shock coils on transformer windings).

— *Adopted without comment.*

Summary 8 :

8. There is a general tendency towards the use of the Buchholz relay as a protective device against internal damage to oil immersed transformers.

— *Adopted without comment.*

Summary 9 :

9. It is logical to install a protective device in the air stream of the air cooled transformers.

— *Also adopted unaltered.*

The President (in French). — We now come to the Chapter : *Protection of Static Converters.*

Mr. De Boeck. — *Protection of static converters.*

Summary 10 :

10. For converters with several vacuum enclosures, *complete* protection against overloads and short circuits (external and internal) is assured by the combination of :

a) overcurrent relays actuating the unit H.T. circuit breaker;

b) high-rupturing capacity anode fuses or high.speed overcurrent anode relays;

c) an individual overcurrent cathode relay for each converter. This will be arranged to trip the unit H.T. circuit breaker and disconnect the converter from the D. C. bus bars.

The President (in French). — Here I must remind you that when we were discussing Summary 3, Mr. WALTER suggested we should modify the beginning of Summary 10, and as a result we decided to say : « For converters with several vacuum enclosures of relatively small capacity, protection... » without giving the figures in brackets suggested in Mr. WALTER's text.

Mr. Pick. — No, I think that will be in accordance with present-day knowledge anyway.

The President (in French). — The text of Summary 10 will therefore read :

« 10. For converters with several vacuum enclosures of relatively small capacity, complete protection against overloads and short circuits (external and internal) is assured by the combination of :

« *a)* overcurrent relays actuating the unit H.T. circuit breaker;

« *b)* high-rupturing capacity anode fuses or high speed overcurrent anode relays;

« *c)* an individual overcurrent cathode relay for each converter. This will be arranged to trip the unit H.T. circuit breaker and disconnect the converter from the D.C. bus bars. ».

— *Adopted.*

Mr. De Boeck (in French). — *Summary 11 :*

11. *a*) For converters with a single vacuum enclosure, it is recommended for the protection against the overloads and short circuits to use the H.T. circuit breaker with time delay and instantaneous overcurrent devices;

b) Anode fuses are little used with steel tank rectifiers;

c) Where no anode fuses are installed, a high-speed reverse-current circuit breaker is necessary, if there is a possibility of backfire;

d) Arc-suppression equipment seems to be recommendable, for tensions of 1 to 1,5 kV or more, or if high power units are involved.

The President (in French). — Mr. WALTER suggested just now that we should modify the beginning of Summary 11 *a)* as follows : *a)* For converters of higher capacity with a single vacuum enclosure... »

Do you agree? *(Agreed).*

The text will therefore read :

« 11. *a)* For converters of higher capacity and with a single vacuum enclosure, it is recommended, for the protection against overloads and short circuits, to use the H.T. circuit breaker with time delay and instantaneous overcurrent devices :

« *b)* Anode fuses are little used with steel tank rectifiers;

« *c)* Where no anode fuses are installed, a high-speed reverse-current circuit breaker is necessary, if there is a possibility of back-fire;

« *d)* Arc-suppression equipment seems to be recommendable for tensions of 1 to 1.5 kV or more, or if high power units are involved. »

— *Adopted.*

Mr. De Boeck (in French). — *Summary 12 :*

12. In order to protect steel tank rectifiers against excessive heating, *thermostats* are currently used. They either :

a) give a warning signal;

b) actuate or control the cooling system (air or water), or

c) shut down the unit.

These thermostats are necessary wherever no other protective devices against overload exist.

— *Adopted.*

Mr. De Boeck (in French). — *Summaries 13 and 14 :*

13. The most rational protective device against a failure in the cooling system controls the circulation of the cooling medium (water or air).

14. The protections against ignition or excitation failure are : the shutting down, at least temporary, of the rectifier unit; however, for attended substations, an alarm system is sufficient.

— *Summaries 13 and 14 were adopted without any change.*

Mr. De Boeck (in French). — *Summary 15 :*

15. For converters with continuous pumping, it is necessary to protect against the loss of vacuum. The action should be the same as for the ignition failure.

Mr. Walter (in French). — I suggest we modify the text of this summary and replace the second phrase by the following formula : « If a protective device against loss of vacuum is installed, the action should be the same as for an ignition failure. »

There is in fact a protective device against loss of vacuum which has caused trouble, which is why I suggest the modification in question.

The President (in French). — Personally, I agree with you, as we have also had trouble on the S.N.C.V.

Mr. de Boeck (in French). — The Belgian Railways have no protective device against loss of vacuum any longer, they have an indicator and the vacuum pumps work permanently.

The President. — Do you always use a device of this sort in England, Mr. PICK?

Mr. Pick. — Yes, we always have on the pumped type, special relays for cutting out on the vacuum. We always use a Pirani gauge, continuously excited.

The President. — And you always have a device of this sort?

Mr. Pick. — Yes, on all pumps.

The President. — But there would not be any objection to adding « if such a device is necessary »? You consider such a device is necessary; we can therefore say « if such a device is necessary. »

Mr. Pick. — The difference is that of course we switch out, not as in the case of the excitation failure, where there is an alarm.

The President. — But all your substations are completely automatic?

Mr. Pick. — Not all, no. We have a good mixture of pumped and pumpless which are both automatic and manned.

Mr. De Boeck (in French). — On other Railways, there is only an alarm device, this is why the action of the device should be the same. It seems to me that this is quite true; if it is necessary to cut out owing to ignition failure, we must cut out when there is loss of vacuum; if it is sufficient to signal the ignition failure, then it is only necessary to signal the loss of vacuum.

The President (in French). — The modified text will therefore read : « If a protective device against loss of vacuum is installed, the action should be the same as for ignition failure. »

Mr. De Boeck (in French). — And the wording of Summary 15 will be as follows :

« 15. For converters with continuous pumping, it is necessary to protect against the loss of vacuum. If a protective device against loss of vacuum is installed the action should be the same as for the ignition failure. »

The President (in French). — But in fact Mr. WALTER when there is lag of vacuum, it is quite simple, the protective device comes into action to work the pump. The protective device against ignition failure, is it used as an alarm or to put out of service?

Mr. Walter (in French). — We put on the MacLeod vacuum gauge to check the vacuum during maintenance or repair work.

The President (in French). — I think we can accept the modification you suggested. *(Agreed.)*

— *The final text of Summary 15 will be given at the Meeting on the 25th May.*

Mr. De Boeck (in French). — *Summary 16 :*

16. A surge arrestor is generally installed on each anode.

— *Adopted without discussion.*

Summary 17 :

17. Automatic voltage control is little or rarely practised because of complexity.

— *Adopted without discussion.*

The President (in French). This brings us to the Chapter : *Protection of contact lines and their power supply feeders.*

Mr. De Boeck (in French). — *Protection of contact lines and their power supply feeders.*

Summary 18 :

18. High-speed circuit breakers are used for both A.C. and D.C. systems as a protection against overloads and short circuits.

Mr. Walter (in French). — I suggest the following text for Summary 18 :

« As a protective measure against overloads, high speed circuit-breakers are generally used on D.C. systems.

On A.C. traction systems, the tendency is to reduce the duration of short circuits to a minimum by the adoption of circuit-breakers which are faster than those used on the transmission lines. »

In this text we have added further details about the time the circuit-breakers take to work on A.C. electrified systems.

The President (in French). — You have therefore gone in for faster working?

Mr. Walter (in French). — Faster than those generally used on the transmission lines. We have endeavoured to take greater precautions than those used for the transmission of high tension current. This does not concern D.C. traction.

The President (in French). — As far as I know, the Swedish Railways have gone even further.

Mr. Walter (in French). — But on the Swedish railways it is question of 16 2/3 Hz. That is why 150/1000 second is a value acceptable to everyone.

The President. — In England, I suppose, Mr. PICK, you use alternating current?

Mr. Pick. — No, we have no A.C. traction of any kind.

The President. — So you would have no objection to the suggested modification?

Mr. Pick. — No, I don't object.

The President (in French). — The text of Summary 18 will therefore read :

« 18. As a protective measure against overloads, high-speed circuit-breakers are generally used on D.C. systems. On A.C. traction systems, the tendency is to reduce the duration of short circuits to a minimum by the adoption of circuit breakers which are faster than those used on the transmission lines. »

— *Adopted.*

Mr. De Boeck. *Summary 19 :*

19. The protection of contact lines against voltage surges is a matter of local circumstances.

The tendency is to use an electronic surge arrestor or condenser.

Mr. Walter (in French). — I am not quite clear what is meant by electronic surges. On the S.N.C.F. we often use carbosial, resorbite, etc. Is this what is meant? And it seems to be of interest to mention it.

The President. — Perhaps Mr. PICK could give us an explanation of the electronic surges mentioned in Summary 19? Mr. WALTER wants some more information about this subject.

Mr. Pick. — Well, I think the trouble is there are so many varieties, but in general terms they are of the ignitron or cold cathode type of spill-over circuit, which then makes a contact on a resistance discharge circuit.

Mr. Walter. — I thank Mr. PICK for this information. We do not use this type.

The President (in French). — In this summary we wanted to show the tendency; we did not intend to imply that there is no other devices used, but we think that the tendency is to use condenser or electronic surge arrestors.

The electronic surge arrestors are ignitrons which make a contact with a discharge resistance. They are used above all in the countries covered by the English Reporter.

— *Summary 19 is adopted without change.*

Mr. De Boeck (in French). — *Summary 20 :*

20. The disadvantages of the parallel operation of substations can be taken care of by means of a combination between the characteristics of the circuit breakers in the substations and in the switching stations.

— *There were no criticisms of this Summary.*

The President (in French). — We now come to the Chapter : *Protection of electric motor vehicles.*

Mr. De Boeck (in French). — *Protection of electric motor vehicles.*

Summary 21 :

21. On D.C. systems of 1,5 kV and less, ordinary circuit breakers are used for the protection against overloads and short circuits. Fuses are also used.

On D.C. systems of ± 3 kV, high-speed circuit breakers, controlled by overload relays, are used. Differential relays are extensively used.

Mr. Walter (in French). — In this Summary it is stated : on D.C. systems of 1.5 kV and less... »

We fit our motors with high speed circuit-breakers and I think the summary should be modified accordingly : « On D.C. systems of less than 1.5 kV... »

The President (in French). — The text of the summary is an exact report of the situation shown by the replies received by Mr. DE BOECK.

Mr. de Boeck (in French). — On the Netherlands Railways for example, it appears that they prefer to use ordinary circuit breakers.

Mr. Walter (in French). — Perhaps we could take every situation into account by saying : « ...and in certain cases 1 kV... »

Mr. De Boeck (in French). — I intended to suggest the following text : « On systems of less than 1 kV, as a protection against overloads, high speed circuit breakers are used for the higher powers and ordinary circuit-breakers for the others. »

Perhaps Mr. Pick would be good enough to tell us if his railway uses high speed circuit-breakers even on vehicles of lower power?

Mr. Pick. — We generally reckon on 600 volts.

The President. — For low powers?

Mr. Pick. — Because we use high speed on our 600 volt circuits — quite high speed breakers.

Could we use the words « can be » instead of « are »?

The President. — But Mr. Pick are these 600 V high speed circuit breakers used on the vehicles?

Mr. Pick. — Yes, yes.

The President. — What is the capacity of these motors, what is their power?

Mr. Pick. — 390 amperes.

The President (in French). — I propose we accept Mr. Pick's suggestion that Summary 21 be worded as follows :

« 21. On D.C. systems of 1.5 kV and less, ordinary circuit breakers *can be used* for the protection against overloads and short circuits, and fuses can also be used.

« On D.C. systems of ± 3 kV, high-speed circuit breakers, controlled by overload relays, are used. Differential relays are extensively used. »

— *Adopted.*

Mr. De Boeck (in French). — *Summary 22 :*

22. On D.C. systems the protection against voltage surges, when provided, is in general realised by means of devices with condensers.

Mr. Walter (in French). — In Summary 22, it is a question of protection against voltage surges by means of condensers; on the S.N.C.F., we also use semi-conductive materials as a protection against voltage surges. Perhaps it is not essential to report this.

The President (in French). — We might add : « ...and sometimes with semi-conducting materials. »

The modified text of Summary 22 will therefore read :

« 22. On D.C. systems the protection against voltage surges, when provided, is in general realised by means of devices with condensers, and sometimes with semi-conducting material. »

— *This text is adopted.*

Mr. De Boeck (in French). — *Summary 23 :*

23. On powerful units, and especially for D. C. tensions of the order of 1.5 kV and more, a no-volt tripping is normally provided.

— *Adopted without discussion.*

The President (in French). — We now come to the final chapter : *Regenerative braking.*

Mr. De Boeck (in French). — *Regenerative braking.*

Summary 24 :

24. The protection should conform to the following essential conditions :

1° A safe and efficient alternative means of braking must be available under all circumstances. This braking must come into operation *in a very short time,* should the possibility of regenerative braking disappear;

2° Any over-voltage must be prevented.

The President (in French). — You also use regenerative braking in France, don't you Mr. WALTER ?

Mr. Walter (in French). — We use this system on certain lines with steep gradients.

The President. — Has Mr. PICK anything to add ?

Mr. Pick. — Well, the only point I have is in the last sentence of Summary 24, I should like to say « Over-voltages must be prevented », not « Any over-voltage must be prevented », because you must have some over-voltage. Cut out the word « any » and that I think reads correctly, because you must have some overvoltage in order to break into regeration.

The President (in French). — This will be taken into account in the final text of this Summary.

Gentlemen, I suggest that we now adjourn and we will meet again to-morrow morning to read the Summaries through a second time and if needs be decide on their final form.

The meeting ended with a discussion between the PRESIDENT, Mr. DE BUSSCHERE, *Lower Congo to Katanga Railway,* and Mr. WALTER on various subjects, amongst others regenerative braking and the use of Diesel-electric locomotives on colonial railways.

— *The meeting adjourned at* 11 a.m.

Meeting held on the 25th May 1954.

PRESIDENT : W. A. VRIELYNCK.

— The meeting began at 9 a.m.

The President. — Gentlemen, we are going to read through the summaries adopted at yesterday's meeting, some of which have been revised or slightly amended to take into account the comments made during the discussions.

Will Mr. DE BOECK, the *Special Reporter,* please be good enough to read the Summaries through again.

— *Summaries 1 to 14 were read through without any comment.*

Mr. De Boeck. — *Summary 15 :*

« 15. For converters with continuous pumping, it is necessary to protect against the loss of vacuum. If a protective device against loss of vacuum is installed, the action should be the same as for the ignition failure. »

Mr. Walter (in French). — In fact, we do not provide any protective device.

Mr. Pick. — If there is a loss of vacuum we want the rectifier off immediately.

Mr. De Boeck (in French). — Or an alarm system for both of them is considered sufficient.

The President (in French). — No.

Mr. De Boeck (in French). — Then what happens in case of ignition failure?

The President (in French). — We must alter this summary. I do not think Mr. WALTER was of this opinion, but he did not agree that it was essential to have a device.

I think it would be better to retain the amendment Mr. WALTER suggested yesterday which was in fact taken into account in the new text : « If a protective device is considered necessary... »

Mr. Pick. — I should say that was wrong, very wrong — once the vacuum starts falling, get the thing off before you get a surge on the system.

The President. — You do not agree with Mr. WALTER?

Mr. Pick. — No, I don't.

The President. — What do you suggest therefore? What protective device have you against ignition or excitation failure?

M. Pick. — Merely alarm.

Could we not say : « A protective device against loss of vacuum is usual for converters with continuous pumping. In attended substations, however, an alarm system may be sufficient. »

The President. — Yes, that is my opinion. But we want to add that we have no device of this sort in the substations and the French Railways do not have this protection. I would suggest saying : « For converters with continuous pumping some Administrations provide a protective device against loss of vacuum. In attended substations however, an alarm system may be sufficient. »

Mr. Pick. — Yes, that is all right, but « some » is rather smaller than the general running I think.

The President. — In France, there is no such protection.

Mr. Pick. — I think they are rather the exception, aren't they?

The President (in French). — I suggest the following text :

« 15. For converters with continuous pumping, some Administrations provide a protective device against loss of vacuum.

« In attended substations, however, an alarm system may be sufficient. »

— *This new text is adopted.*

Summaries 16 to 23 were read without comment.

The President (in French). — In the case of Summary 24, I remember at our last meeting Mr. PICK asked that the word « any » should be deleted from the English text, simply saying under 2) « Over-voltage must be prevented ». In the case of the corresponding French text I propose saying : « 2. parer aux élévations de tension inadmissibles. » *(Agreed.)*

The final text is as follows :

« 24. The protection should conform to the following essential conditions :

a) A safe and efficient alternative means of braking must be available under all circumstances. This braking must come into operation in a very short time should the possibility of regenerative braking disappear;

b) Over-voltage must be prevented. »

Gentlemen, this brings us to the end of our agenda. Before we disperse, I would like to thank you for your kind cooperation. My particular thanks are due to the Reporters Mr. PICK and Mr. DE BOECK as well as to our Principal Secretary Mr. CHARLIER. *(Applause.)*

— The meeting ended at 10 a.m.

DISCUSSION AT THE PLENARY MEETING.

Meeting held on the 26th May 1954.

President : Sir Brian Robertson.
General Secretaries : Messrs. P. Ghilain and C.E. Whitworth.

The President. — We now come to Question 11.

Mr. Ghilain, *General Secretary* (in French), read the summaries adopted, which were published in Nos. 4 and 5 of the Daily Journal of the Congress.

(This did not give rise to any comments.)

The President. — We can therefore consider the summaries for Question 11 as ratified.

SUMMARIES.

Protection of high-tension distribution systems.

« 1. The relay types of current manu-
« facture assure an acceptable protection.

« 2. *a)* The protection of each point of
« distribution, including traction substa-
« tions, is recommended.

« *(b)* In order to obtain an adequate
« protection of the installations, the
« protection should include overcurrent
« relays, combined with earth fault relays;
« in this respect, relays of the differential
« type are not sufficient.

Protection of static transformers.

« 3. The ideal protection against over-
« loads and short circuits consists of a
« group of two devices which control the
« tripping of the primary circuit breaker :

« *(a)* by an instantaneous overcurrent
« element;

« *(b)* by a device which includes an
« element whose temperature would pro-
« duce *that of the hottest spot of the*
« *windings.*

« The protection against overloads of
« converter units being such as to amply
« cover that of transformers, it is possible
« to dispense with protection of trans-
« formers themselves.

« 4. Theoretically, it is the « thermal
« image» which assures the most adequate
« protection against excessive heating.

« 5. Overcurrent time delay relays
« assure an acceptable protection for all
« practical purposes.

« Thermal relays of this type do not present any marked advantage.

« 6. For oil immersed transformers, the
« use of contact thermometers measuring
« the oil temperature or thermostats gives
« a supplementary protection.

« 7. No H.T. surge arrestor offers a
« completely reliable protection. Their
« installation is not indispensable, espe-
« cially when other devices *ad hoc* exist

« (earth wires on overhead distribution « lines, shock coils on transformer windings).

« 8. There is a general tendency towards « the use of the Buchholz relay as a « protective device against internal damage to oil immersed transformers.

« 9. It is logical to install a protective « device in the air stream of the air « cooled transformers.

Protection of static converters.

« 10. For converters with several vacuum enclosures of relatively small « capacity, complete protection against « overloads and short circuits (external « and internal) is assured by the combination of :

« *a)* overcurrent relays actuating the « unit H.T. circuit breaker;

« *(b)* high-rupturing capacity anode « fuses or high speed overcurrent anode « relays;

« *(c)* an individual overcurrent cathode « relay for each converter. This will be « arranged to trip the unit H.T. circuit « breaker and disconnect the converter « from the D.C. bus bars.

« 11. *(a)* For converters of higher « capacity and with a single vacuum « enclosure, it is recommended, for the « protection against overloads and short « circuits, to use the H.T. circuit breaker « with time delay and instantaneous « overcurrent devices;

« *(b)* Anode fuses are little used with « steel tank rectifiers;

« *(c)* Where no anode fuses are installed, a high-speed reverse-current circuit « breaker is necessary, if there is a « possibiltiy of back-fire;

« *(d)* Arc-suppression equipment seems « to be recommendable for tensions of « 1 to 1.5 kV or more, or if high power « units are involved.

« 12. In order to protect steel tank « rectifiers against excessive heating, thermostats are currently used. They « either :

« *(a)* give a warning signal;

« *(b)* actuate or control the cooling « system (air or water), or

« *(c)* shut down the unit.

« These thermostats are necessary « where-ever no other protective devices « against overload exist.

« 13. The most rational protective « device against a failure in the cooling « system controls the circulation of the « cooling medium (water or air).

« 14. The protections against ignition « or excitation failure are : the shutting « down, at least temporary, of the rectifier « unit; however, for attended substations, « an alarm system is sufficient.

« 15. For converters with continuous « pumping, some Administrations provide « a protective device against loss of « vacuum.

« In attended substations, however, an « alarm system may be sufficient.

« 16. A surge arrestor is generally « installed on each anode.

« 17. Automatic voltage control is « little or rarely practised because of « complexity.

Protection of contact lines and of their power supply feeders.

« 18. As a protective measure against « overloads, high-speed circuit-breakers « are generally used on D.C. systems. On « A.C. traction systems, the tendency is « to reduce the duration of short circuits « to a minimum by the adoption of « circuit breakers which are faster than « those used on the transmission lines.

« 19. The protection of contact lines « against voltage surges is a matter of « local circumstances.

« The tendency is to use an electronic « surge arrestor or condenser.

« 20. The disadvantages of the parallel « operation of substations can be taken « care of by means of a combination « between the characteristics of the circuit breakers in the substations and in « the switching stations.

Protection of electric motor vehicles.

« 21. On D.C. systems of 1.5 kV and « less, ordinary circuit breakers can be « used for the protection against over« loads and short circuits, and fuses can « also be used.

« On D.C. systems of ± 3 kV, high« speed circuit breakers, controlled by « overload relays, are used. Differential « relays are extensively used.

« 22. On D.C. systems the protection « against voltage surges, when provided, « is in general realised by means of « devices with condensers and sometimes « with semi-conducting material.

« 23. On powerful units, and especially « for D.C. tensions of the order of 1.5 kV « and more, a no-volt tripping is normally « provided.

Regenerative braking.

« 24. The protection should conform to « the following essential conditions :

« *(a)* A safe and efficient alternative « means of braking must be available « under all circumstances. This braking « must come into operation *in a very « short time*, should the possibility of « regenerative braking disappear;

« *(b)* Over-voltage must be prevented.»

[625 .233 (493)]

The latest electric heating and electric heating control devices applied by the Belgian National Railways,

by E. Meyer,

Ingénieur principal au Service du Matériel et des Achats de la Société Nationale des Chemins de fer belges.

INTRODUCTION.

The heating of trains is governed by two conflicting requirements.

The heating effect must be rapid, i.e. it must be able to bring into play, within a comparatively short time, a high enough calorific power to permit the vehicle to be taken into service in a well-heated condition at the beginning of its working day.

On the other hand, it must be economic in power consumption and only just compensate for the energy losses due to radiation, ventilation and convection during the running of the vehicle.

Tests carried out by the Belgian National Railways (S.N.C.B.) have shown that the power required to bring, within 50 minutes, the air temperature within a steel-bodied coach from 0° to 18° C is of the order of 28 kW, if the coach is stabled in the open at an ambient temperature of 0° C.

The power required to maintain the temperature of 18° C at a speed of 120 km/h (74 m.p.h.) with an ambient temperature of 0° C is only 15 kW.

The temperature control of electric heating apparatus poses a series of problems which the author had occasion to study, and for which he suggests a new solution, discussed later on.

Typical features of steam heatings.

The temperature control of steam heating apparatus is a fairly simple proposition, owing to the properties of steam and the nature of the apparatus used.

The driver of the steam engine is able to exercise a highly effective overriding control.

By opening the feed valve of the train line to a greater or smaller degree, he is able to correct any deficiency or excess in the heating output.

The steam radiator consists of a heating pipe which has a temperature of about 100° C.

If the ambient space of a compartment is small, the heat exchanges between the radiator and the ambient air are intense. When the temperature in the compartment has risen, the temperature differential between the heating elements and the ambient air is reduced, resulting in a reduced efficiency of the heating apparatus.

Moreover, there is no great difficulty in operating a valve and providing the appropriate control lever system. It is therefore possible to place at the disposal of passengers a manual control system permitting the reduction of temperature in the compartment.

Typical features of electric heating.

With electric energy, such a simple control system is not practicable, at least not at high direct-current voltages.

The train driver may either connect or disconnect the heating. But, in contrast to what the steam engine driver can do, he cannot reduce the input partly.

The heating element generally consists of an electric wire enclosed in a steel tube which is filled with insulating materials. When in operation, this pipe is heated to a very high temperature (300 to 450° C).

It is obvious that a difference of a few degrees in the ambient temperature can only have a limited influence on the effectiveness of the installation.

The Belgian Railways use a traction voltage of 3 000 volt D.C., which is excellently suited for traction purposes, but does not permit, except at prohibitive cost, the provision of the numerous switches which might be placed at the disposal of passengers for the purpose of reducing the calorific input of the radiators.

Electric heating apparatus of conventional types.

A. — *Forced-air heating.*

Forced-air heating has been used in 1935 for the twelve four-car sets of the Brussels-Antwerp line, and for the 16 cars acquired in 1939.

This type of heating, attractive at first sight, has been developed abroad and particularly in France where a great number of cars have been equipped with it. Vehicles equipped with forced-air heating are also used on the railway systems of Luxemburg, Switzerland and the Netherlands.

In principle, the apparatus consists of an electric resistance heating a flow of air which is generated by a blower motor and subsequently distributed to the compartments.

The overall efficiency of such an installation is poor, because the air in the vehicle is held under a higher pressure than the circumambient air so that the heat losses are high.

The tests carried out by the S.N.C.B. have shown that the average consumption of heating energy amounts to about 170 % of the consumption of a vehicle equipped with ordinary radiators as described later.

Moreover, the weakness of the original installation is the blower motor.

The motor energy was originally supplied by the battery. Any trouble at the battery, or the blowing of a fuse, causes a breakdown of the heating and possibly the destruction of the heating battery if the safety devices do not act in good time.

Outbreaks of fire which have occurred in several vehicles abroad have shown that this objection is not merely academic.

Safety devices controlled at high temperatures of the order of 200° C are never quite reliable in the case of apparatus exposed to mechanical stresses of the importance encountered with railway rolling stock.

If the safety devices are controlled at too low a level, untimely breakdowns of the heating apparatus and justified complaints of passengers might be the consequence.

In order to obviate these drawbacks at least to some extent, the blower motor now obtains its power supply from the terminal of the heater resistance.

The problem of controlling the temperature in the compartments has been solved in two different ways.

With the Belgian rolling stock dating from 1935, the heating is controlled by means of a thermostat which connects or disconnects the circuit breaker of the heating resistance.

This control system can be satisfactory if the flow of hot air is the same below each seat, except for a slight increase in the vicinity of the doors.

The flow is regulated by means of dampers which are periodically adjusted at the repair shops.

However, an obstruction in the ventilation circuit of a seat can only be remedied after it has been found or, in other words, when it is too late.

Certain foreign Railway Administrations have studied the possibility of using the forced-air heating system in coaches with a great number of compartments.

In this case, the control device used in Belgium is obviously unsuitable as the air conditions vary greatly as between one compartment and another. The degree of tightness may differ greatly as between adjacent compartments, and the vicinity of the entrance vestibules has a great influence on the temperature drop in a coach.

French engineers, who have studied this type of heating very thoroughly, have applied the following principles :

a) The heating battery is divided into two parts.

Initially, the whole power of the battery is brought into play. During the running, however, the temperature is maintained by a part of the resistance only, the remainder being disconnected.

For this purpose, the blower motor must of course be designed for working at two different speeds.

b) Temperature is no longer controlled by a thermostat but by a device ascertaining the mean temperature in four specimen compartments.

This is done by means of four series-connected resistances, one in each compartment selected. Each resistance is influenced by the ambient conditions in the compartment concerned.

All these resistances are made to form part of a Wheatstone bridge which, by means of relays and contactors, regulates the heating installation of the entire coach.

These two principles are very attractive at first sight. In practice, however, their application has not proved to be as successful as certain promoters could legitimately expect.

The connection between the blower and motor sets and the battery has not been eliminated.

A new perturbing factor arises : the contact resistances between the terminals and the resistances used for the sampling.

These contact resistances play an important part because the increase in the ohmic resistance as a function of the temperature of a sampling resistance is fairly small.

The control apparatus is liable to get out of order due to ageing so that the temperature is always adjusted at too high a value.

The passengers react by opening the compartment window so that the sampling resistance cools down further, thus increasing the discomfort in the other compartments.

As a palliative to these shortcomings, one has recently thought of placing at the disposal of passengers a flap permitting the diversion of excess heat to the corridor. This solution does not improve the overall economics of the system, as a calory obtained from electricity is very costly; comfort, on the other hand, will certainly be improved as compared with the present system.

B. — *Heating by means of convection and radiation.*

On most railway systems, the vehicles running on electrified lines are equipped with convection radiators or with convection and radiation radiators.

This apparatus offers certain advantages compared with the forced-air heating system :

a) savings in first cost (at least 50 %);

b) reduced electricity consumption;

c) simplicity of operation;

d) practically complete absence of fire risk.

The drawbacks usually encountered with the older installations are these :

a) comfort rather reduced owing to the excessive power installed and the inadequate regulation;

b) much space required for the radiators under the seats or along the corridor walls.

Apparatus installed in Belgian international coaches in 1951-1953.

Most of the international coaches of the Belgian Railways were re-fitted in 1951-1953 to permit their use on the Belgian and foreign railway lines about to be electrified.

These installations have been the subject of systematic research. On this occasion, the author has been able to collect data permitting a close study of the equipment for the 100 new coaches under construction.

The electric heating of international coaches is rendered complicated by the disparity of the electric voltages used on different systems.

France and the Netherlands use 1 500 volt D.C.

Switzerland, Austria, Germany and Sweden use 1 000 volt at 16.2/3 cycles.

Belgium, Italy and Jugoslavia use 3 000 volt D.C.

France has asked for the use of 1 000 volt A.C. at 50 cycles.

The coaches concerned must be able to work with all these different rated voltages, whilst the actual voltages may differ by nearly 20 % from the values of the rated voltages.

The apparatus designed to put the heating resistances of each compartment in series, in series-parallel or parallel is housed in special boxes fitted below the car.

In the international coaches of the Belgian Railways, each compartment has an independent heating system. The temperature in each compartment is thermostat-controlled. In addition, a switch is provided which enables passengers to switch the thermostat in or out. It is therefore a very costly installation.

One could therefore hope that the comfort in the coaches would thus attain an unprecedented degree. However, after the first test in 1951, one had to « climb down ». Comfort was greatly jeopardized by overheating.

First, the thermostat was blamed.

However, the Sauter thermostat used for this purpose is beyond reproach. In fact, when dismantled and tested under laboratory conditions, the thermostat proved to be able to regulate the temperature with a tolerance of 0.5° C around the predetermined point.

The same thermostat, again mounted in a compartment, permitted a temperature fluctuation between 18 and 29° C. Dismantled and tested once more, the apparatus again worked perfectly.

The problem of temperature control became a fascinating task except for the passengers who rightly found that the apparatus was far from being perfect.

Systematic tests have shown that it is easier to control the temperature in a coach composed of few large compartments than in one containing numerous small compartments.

In a coach consisting of few large compartments, the desired temperature is established without previous fluctuations. In contrast, the thermostat controlling a coach with many small compartments must go through two or three cycles of connection and disconnection before beginning to control the temperature. This is due to the influence of the walls which show a thermal time lag compared with the ambient air.

To enable the thermostat to work properly, it was not sufficient to lower the cut-out temperature of the heating circuit breaker as, on this basis, the restoration of the heating current would have occurred at too low a temperature.

If, in order not to exceed an upper temperature limit of 20° C, it would have been sufficient to set the cut-out temperature at 12° C, the temperature in the compartment would have fluctuated between 12 and 20° C which would have been intolerable.

With the original conditions of the apparatus, the thermostat acted too late. In other words, the heating current was cut out after a certain delay, for the following reasons :

a) the *inertia of the heating elements*, which continued to radiate calorific energy for several minutes after the current had been cut off;

b) the *influence of the walls.*

The influence of the walls is all the greater, the smaller the compartment, a fact which explains the initial behaviour of the heating in the coaches with numerous small compartments.

The walls, being colder than the ambient air by which they are heated, have the effect of delaying the cutting out of the current by the thermostat.

The thermostat can be sensitized by eliminating its inertia.

For this purpose, a resistance has been placed close to the sensitive element of the apparatus; this resistance is supplied with current when the thermostat requires the heating to be on, so that the temperature rise in the sensitive part of the apparatus is speeded up.

When the thermostat has reached the cut-out temperature, the resistance is disconnected and the apparatus is allowed to cool off.

By connecting a resistance of 100 ohms to the contactor circuit of each compartment, it has been possible to stabilize the temperature in each compartment within ± 1° C of the mean temperature.

An even more accurate control system would not offer any advantage as regards the improvement of comfort, whilst the maintenance cost would be increased because of the inability of the high tension circuit breakers to operate repeatedly at close intervals.

Multiple-unit trains, series 1950 and 1953.

The experience acquired with the coaches destined for international working has been put to good use for the design of the electric heating equipment for the multiple-unit trains on the electrified line Antwerp-Charleroi.

These vehicles are heated by convection radiators with « all or nothing » control, having one thermostat per car.

In spite of the simplicity of the apparatus, the temperature control obtained by the « sensitized » Sauter thermostats is very satisfactory.

This device has been found so efficient that it was decided, early in 1954, to replace the old thermostats used for the older multiple-unit trains, for the pre-war steel coaches and for the railcars by Sauter thermostats with characteristics identical to those referred to above.

When this equipment has been delivered, these vehicles will therefore be much more comfortable than at present.

Improvements applied to the 100 coaches under construction.

The experience previously acquired has permitted to formulate the following principles :

1) An important power input is required for the preheating of the vehicles;

2) A power input equivalent to one half of the initial input is sufficient to maintain a comfortable temperature;

3) All other things being equal, the sheet of warm air passing along the edge of the seat cushions must have as low a temperature as possible in order not to incommodate the passengers, because the feeling of hot air flowing along the legs is extremely unpleasant.

In order to obtain this result, it is necessary to multiply the number of radiators, to give them as large a surface as possible, to eliminate the « draught » of the radiators and to place them in the centre of the seat.

These requirements are sometimes conflicting so that it is necessary to find the best compromise by means of trial and error.

In their research work, the S.N.C.B. have collaborated with the specialists of the S.E.M. Company. The collaboration with the technicians of this company which had gone so far as to construct a cold room containing a full-size model of a compartment fitted with proper seats, has been of great advantage to the two parties.

The 100 new cars now under construction will be equipped with a heating installation which will bring about a maximum of comfort without any appreciable increase in the cost.

The following means have been adopted to achieve this objective in accordance with the three principles outlined above :

a) All the seats have been equipped with radiators placed in the centre line of the seats.

b) The radiators have been grouped in two circuits so that each of them feeds an identical number of heating elements which are staggered in relation to the longitudinal axis of the car.

c) Each radiator circuit is controlled by a high tension circuit breaker which is controlled by a thermostat.

d) The thermostats are sensitized and set for two different temperatures, the one for 16° C and the other for 19° C.

How the installation works.

At the beginning of the preheating phase, both circuits are in operation. When the temperature has reached 16° C, the first thermostat trips the corresponding circuit breaker, and the vehicle continues to be heated, but with half the power input, until a temperature of 19° C is reached.

If, by that time, the vehicle is still stationary, the thermostat preset for 19° C trips the corresponding circuit breaker at the proper moment and continues to regulate the temperature of the vehicle within ± 1° C of the prescribed temperature.

If the vehicle is in motion, the calorific energy supplied by the radiators just about compensates the heat losses and the temperature of the vehicle remains virtually constant, except at very low external temperatures.

If the outside temperature is very low, a single radiator circuit is inadequate to maintain the desired temperature of + 19° C. But, as soon as the temperature drops to + 16° C, the second thermostat preset for that temperature goes into action and restores the circuit of the other series of radiators.

At that moment, full power is on, and present experience has shown that the temperature can easily be maintained in that way at a constant level, satisfactory even at very low outside temperatures.

The temperature will therefore fluctuate between + 16° and + 19° C, which is very satisfactory even with outside temperatures as low as — 20° C.

Improvements in detail are still possible.

The heating switchboard provides for a series of circuit breakers by which the thermostats can be cut out, either in order to make up for a defect in their circuit, or for the purpose of testing and checking the equipment.

The vehicles concerned are to be taken into operation during 1955; they will mainly run on the electrified line Ostend-Brussels-Liège so that this main artery will have the most perfect rolling stock in the country.

[**656** .2 (68)]

A full programme for South African Railways.

Expression of confidence in rail transport,

by D. H. C. du Plessis, General Manager, South African Railways.

(*Modern Transport*, March 12 and 19, 1955.)

Railway construction and improvements imply the expenditure of millions of pounds and capital costs, by the standards of yesterday, appear to have but a remote relation to the economic principles which used to be observed in railway planning. The South African Railways, in looking back over the past ten years, has been spending at the rate of £ 30 million a year on new projects and the replacement of old or worn-out equipment but is not yet able to move without delays, all the traffic generated by South Africa's vigorously expanding economy demand.

New measures have had to be embarked upon and today the South African Railways is (1) carrying out a long-range programme, (2) preparing an additional five-year plan, and (3) has started on certain emergency measures which will cost approximately £ 10 million to carry out.

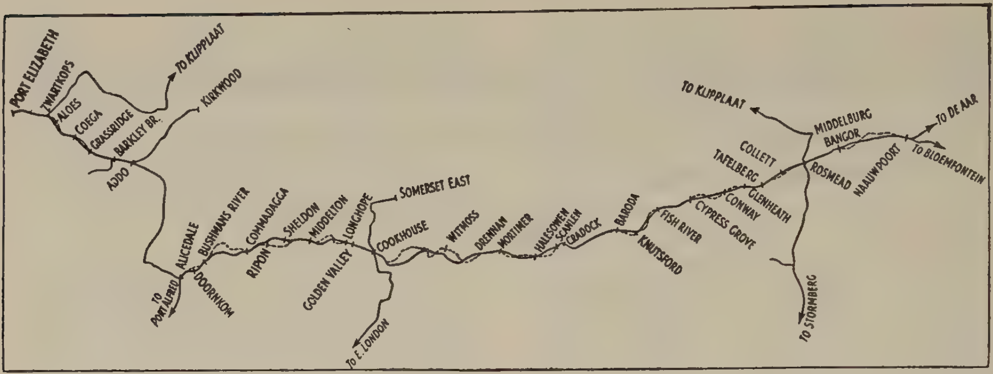
Some of the projects on which work has been in progress for some years have had to be recast on a more ambitious scale than was originally considered necessary because of the unrelenting pressure of traffic. The doubling of the main line from Kroonstad to Bloemfontein is an example. Experience has shown that this line-doubling programme will have to be extended beyond Kroonstad to Vereeniging on the Vaal River, while, on the Transvaal side, further increase in the capacity of the track is essential. The latter need will be met by laying extra tracks and by building an entirely new line from Springs to Natalspruit so that traffic from the Witbank area (mostly coal) will be able to bypass Johannesburg on its way to destinations west and south of the Witwatersrand.

The Natal main line, between Johannesburg and Durban, with additional traffic filtering in from the Free State side, is being used beyond capacity. Instructions have now been issued on Ministerial level to go full steam ahead with the doubling of the line between Maritzburg and Ladysmith. The doubling of certain sections of track between these two points was started before the last war and the work was then considered part of the electrification programme. The whole distance from Durban to Volkrust is electrified. By 1940, 31 miles of track had been doubled. This left approximately 90 miles of the existing 121 miles between Boughton and Umbulwana to be doubled and improved as sanctioned from time to time.

Progress on Natal main line.

To date the sections Tweedie-Lions River (three miles), Dargle-Lidgetton (two miles) and Nottingham Road-Rosetta (three miles) have been completed, and the work is progressing on the sections Rosetta-Mooi River (10 miles), Estcourt-Ennersdale (eight miles), Frere-Colenso (12 miles) and Pieters-Umbulwana (four miles), all of which will be opened this year. When the present scheme is completed there will be a saving in distance between Boughton and Umbulwana of approximately 13 1/2 miles, curvature will be reduced by some 6 800 deg., and all the new deviations will have much flatter curves than at present. In addition, several stations which are now maintained only for train working purposes will no longer be required and will be eliminated.

The heaviest sections of the work are from Boughton to Cedara, Mooi River to

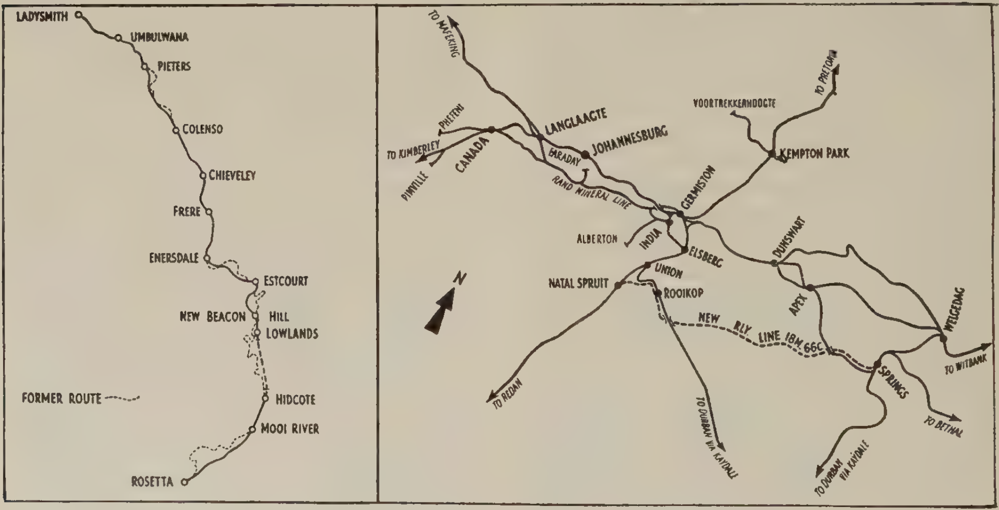


The heavy work involved in the realignment and regrading of the Cape Midland line may be seen from this map which shows also the tortuous course followed by the old line.

Estcourt and Colenso to Umbulwana. The improvements on the section Mooi River-Estcourt include the construction of a double tunnel about two miles in length to replace the existing Stockton tunnel. The ruling grades of 1 in 66 coastwards and 1 in 50 inland remain unaltered due to the topography of the country, but under electrified conditions sufficiently long and heavy trains can be handled without difficulty. The elimination of sharp curves will enable all trains to be speeded up considerably.

Progress of works.

Work has not been started on the 13-mile Boughton-Cedara section, but the existing old line, although it is of a much inferior



The Natal main-line scheme eliminates many severe curves and involves heavy tunnelling near Hidcote; right, the Springs-Natalspruit section bypassing Johannesburg is seen in relation to other lines in the area.

standard, does afford a measure of relief to the main line The bulk of the work between Rosetta and Mooi River including a 1/2-mile tunnel and a reinforced concrete open spandril ribbed-arch bridge of five 60-ft. spans across the river is complete.

The present length of the Mooi River-Estcourt section is 27 1/2 miles, but after deviation of the line the distance will be reduced to 19 1/2 miles and the reduction in curvature on this section alone will be over 4 000 deg. As a result of the deviation four stations will be eliminated. A feature of this section is the heavy earthworks and tunnels owing to the mountainous terrain over which the line is being built. The old main line has been in use since 1922, having been deviated at that time from Newleigh to Estcourt with the advent of electrification The original line was on an extremely steep ruling gradient of 1 in 30 while the present ruling gradient is 1 in 66 opposing the heavy traffic, mainly coal and ores towards the coast, and 1 in 50 opposing the lighter traffic from the coast inland. Advantage was taken of the fact that a falling grade of 1 in 50 would not affect the up line while a corresponding grade of 1 in 66 was needed on the down line.

All tunnels for doubling are separate structures driven independently and they may therefore be at different gradients if, as in this case, such a location is justified. The tunnel on the up line is about 1/4 mile shorter than that on the down line, which represents a very considerable saving in cost. The total cost of this tunnel, including the earthworks and culverts at the approaches, will amount to approximately £ 1 million. Two further twin tunnels, each approximately 3/4 mile long, are to be constructed departmentally on this section. Altogether 1 750 000 cu. yd. of earthworks have to be constructed and the total estimated cost of the work to be done is £ 3 500 000.

As a result of the introduction of doubled main lines, Estcourt Station is being extensively remodelled. A new modern signal cabin equipped with colour-light signalling is to be erected. The civil engineering staff employed on the Natal main-line improvements consists of a district engineer, 10 members of the technical staff, 150 Europeans, 1 300 non-Europeans as well as six private contractors with their staff. Work on this major project has been appreciably accelerated since 1951 and will cost some £ 10 million.

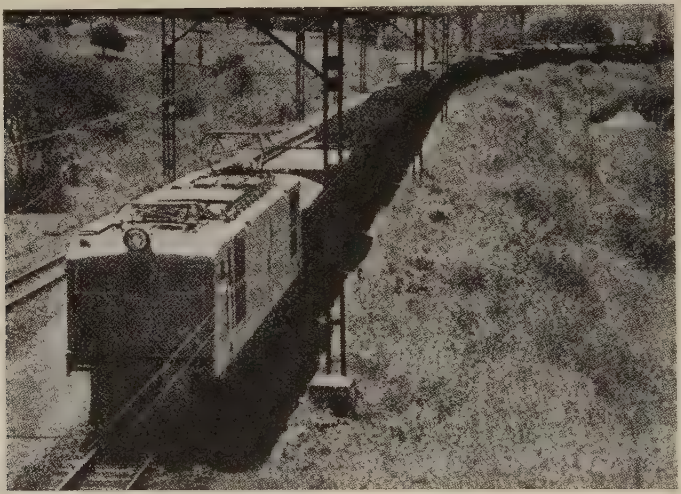
Cape Midlands route.

Some special problems had to be solved in the re-laying, re-routeing and regrading of the Cape Midlands line from Port Elizabeth to the Rand. This line is being turned into the easiest route from the coast to the interior but it has been a long and difficult job to straighten out the curves through the mountainous country which this line encounters as soon as it leaves sea level. There is still much to be done before the improvements reach the stage where this important railway link will be able to play its full part in facilitating the movement of traffic from the coast to the interior.

As a result of improvements made between Port Elizabeth and Groenheuwels during past years, much heavier loads can now be transported over that section of the line. Smooth train working over this section has always been hampered by the many sharp curves and steep gradients, and in order to eliminate the wasteful and costly practice of breaking up train loads the expenditure of £ 6 1/4 million to improve the section between Groenheuwels and Drennan was decided upon.

The whole stretch between Groenheuwels and Cookhouse has now been completed and all heavy gradients have been eliminated over a distance of 127 miles. The section between Groenheuwels and Sheldon, a distance of 22 miles, is a typical example of the type of territory that had to be improved to provide easier and more effective rail transport. Viewed purely from the mileage angle, the completed portion between Groenheuwels and Cookhouse may not appear unduly impressive. But this section, although only 43 miles in length, passes through the most difficult territory on the whole main line, and the regrading of the line not only presented formidable engineering problems but was also a very costly undertaking. Whereas the original construction costs of the old Cape Midland main line amounted to approximately £ 6 000 per mile, the present-day cost of building a single mile of railway track through this mountainous territory averages £ 111 000, an increase of no less than 1 750 %. The fact that the 22-mile section between Groenheuwels and Sheldon actually cost £ 2 1/2 million will give some idea of what the Railway Administration had to spend under present circumstances.

It is interesting to note that the section between Noupoort and De Aar on the Cape Midland System, and between Hutchinson and De Aar on the Cape Western System, were opened to traffic on the same date, viz. Marsch 31, 1884. The original plan was to build the line from Port Elizabeth only as far as Hopetown, where it would have linked up with the railway line from Cape Town, but this was abandoned, and the line constructed through the Free State instead. This indicates that the Cape Midland main line was planned eventually to serve the newly discovered gold mines on the Witwatersrand, as well as the diamond fields.



Freight train on the South African Railways hauled by a North British-General Electric 3 030-HP electric locomotive.

Improvement programme.

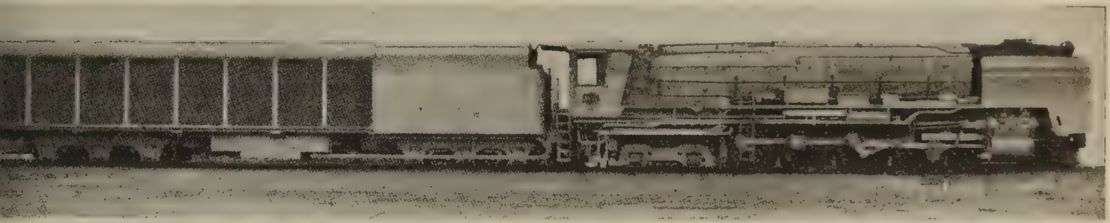
The section of the line between Port Elizabeth and Noupoort was originally constructed with many sharp curves and steep gradients of 1 in 40 uncompensated with the result that either train loads were extremely small, or double-heading had to be adopted if appreciable loads were to be hauled. As traffic over this section continued to increase, an improvement programme was started in the early 1930s and the line was rebuilt to grades of 1 in 80 uncompensated with easier curvature from Port Elizabeth to a point near Bushmans River, a distance of some 82 miles.

Like so many other plans, the rest of the work on this line had to be abandoned on the outbreak of the 1939-45 war. After the war the position was reviewed and it was decided to reduce all gradients to 1 in 80 compensated and that curves should have a minimum radius of 1 320 ft. in the more mountainous areas, and 1 650 ft. over easier country. The newly completed section between Groenheuwels and Sheldon has in fact been improved to a ruling gradient of 1 in 80 compensated in both directions.

There are five tunnels on this particular deviation between Groenheuwels and Sheldon alone, the total length being 11 026 ft., or a little more than two miles. The longest tunnel on this section, and for that matter, in South Africa at the moment, is 4 067 ft. in length and has been built at a cost of approximately £ 703 000. The general rate of progress of work on the Cape Midland line has been speeded up very considerably as a result of improved tunnelling technique. The method originally used in tunnelling was to excavate a small heading, about 8 ft. by 8 ft. by 8 ft. at the roof of the proposed tunnel. This was then widened to the full shape of the arch and followed by removal on the stone to foundation level. Drilling was done by means of hand-held pneumatic drills and the broken rock loaded into the cocopans by means of two small compressed-air driven mine-car loaders. Working 24 hours a day and five and a half days a week, progress was at the rate of 170 ft. per month, with a best month of about 270 ft.

Effect of modern methods.

Towards the end of 1952, this « obsolete » method of drilling was replaced by the most modern methods, using most efficient equipment. The hand-held drills were replaced by 11 power-feed drills mounted on a drill carriage, and instead of 8-ft. holes of 1 1/4-in. dia. which had previously been drilled, holes of up to 14 ft. deep and of 1 1/2-in. dia. could be made, with the resultant use of larger blasting cartridges, while electric delay-action blasting supplemented the old safety fuse method. Removal of the rock was also modernised by the introduction of larger mine-car loaders, loading cocopans of 4 cu. yd. capacity instead of the older 1 cu. yd. type; these large cocopans were then hauled away by fast-moving electric locomotives. In this way, progress increased from 170 ft. to 600 ft. a month with a best month of about 639 ft., while concrete lining increased from 350 ft. to an average of 1 534 ft. a month.



Class 25 4-8-4 condensing locomotive and tender built by the North British Locomotive Co., Limited, for service across the Karoo, where there is a shortage of locomotive water.

There is only one large bridge on this particular section, namely that over the Little Fish River, which consists of eight arches 60 ft. in height. The height from river to track level is approximately 80 ft.

As a matter of interest, old engines such as the obsolete Class A (Belpaire) would have been capable of hauling loads of only 200 to 250 tons over the original line between Port Elizabeth and Noupoort. The Class 12 engines that have been in use for many years, haul 400 to 440 tons each over the existing steep 1 in 40 grades, but will be able to haul 910 tons each, once all the improvements have been completed, while the more powerful Class 15 F engines will take 1 030 tons each — more than 300 % greater loads than the original engines over the original line. This will result in a considerable reduction in operating costs.

Extent of present programme.

The compass of the present programme of expansion goes far beyond the re-laying and regrading of two of the main lines from the coast to the interior. The Eastern main line from East London has already been brought up to new standards while the main line from Cape Town to Johannesburg over the Hex River mountains, over which everincreasing tonnages have to be passed, is receiving special attention. There are many miles of single track between Johannesburg and Cape Town and it has become increasingly difficult to work the required tonnages over a line not designed for presentday demands. Besides the electrification of the section from Bellville to Touws River (240 miles), completed in recent years at a cost of nearly £ 3 million, it was decided to lenghten 66 crossing loops between De Aar and Beaufort West. With the introduction of more powerful locomotives and the urgency of increasing loads per train, the crossing loops, generally about 1 400 ft. in length, are being lengthened to a maximum of 1 900 ft., thus allowing longer trains to be worked over the section. The cost of the work is estimated at £ 310 000. It is hoped to have it completed by the end of May, in time for the heavy coal traffic which has to be moved to the Cape Province during the winter months.

A new line, nearly five miles in length, has been built during the last few months from Kamfersdam to Beaconfield at a cost of £ 185 000. Mineral and ore traffic from the Postmasburg area has been delayed considerably by having to be worked through the hard-pressed Kimberley Station and the new line bypasses Kimberley. At the same time various marshalling yards and locomotive depots along the route are being enlarged and improved. The new line from Springs to Natalspruit, already mentioned, will cost £ 1 850 000. Its main purpose is to relieve the present lines through Johannesburg and to enable coal traffic to be moved more freely.

New Planning Division.

The works already mentioned by no means represent the whole programme of expansion and improvement. A special section has now been established at railway headquarters to co-ordinate planning. Known as the division of planning, coordination and research its job will be to see that the policy of increasing the carrying capacity of the railways so as to measure up to national transport requirements is carried out. The division will work in association with the railway planning council of which the general manager is chairman.

During the last five years, the South African Railways has spent £ 27 250 000 on motive power (steam and electric locomotives) and goods wagons and a further £ 5 million will be spent this year. Early this year 3 000 goods wagons were ordered at a cost of more than £ 5 million and with the delivery during the past two years of new steam and electric locomotives, prospects appear favourable. Other ways and means of improving the railway system are under consideration. Centralised traffic control, or at least a modified form of it, will be introduced on various sections, and the general question of traction is being studied.

The capital invested in the South African Railways and its associated services is nearly £ 450 million and will be considerably increased during the present financial year which will, in all probability, set a new record for capital outlay in any one year. The green light to go ahead in order to bring the railway system up to the required standard has been given. There can be no compromise with public demands. They have to be satisfied, and I am confident that we are nearing the end of the extremely difficult period through which the South African Railways has been struggling.

[621 .338 (494)]

Torsion bar bogies on the Rhaetian Railway.

Swing bolster sprung by transverse torsion bars.

(*The Railway Gazette*, February 11, 1955.)

As a result of experiments with a novel type of bogie designed to provide improved riding at speeds up to 40 m.p.h. on their metre-gauge electrified system, the Rhaetian Railway are equipping four types of carriages with a bogie built by SIG. In addition, the same type of bogie will be fitted to certain vehicles operating on the Furka-Oberalp and Visp Zermatt rack sections. The use of the bogie will be extended to other stock as opportunity offers. This bogie is the SIG (Swiss Industrie Gesellschaft, of Neuhausen) torsion-bar pattern of which about 700 are now in service on some 12 different railways.

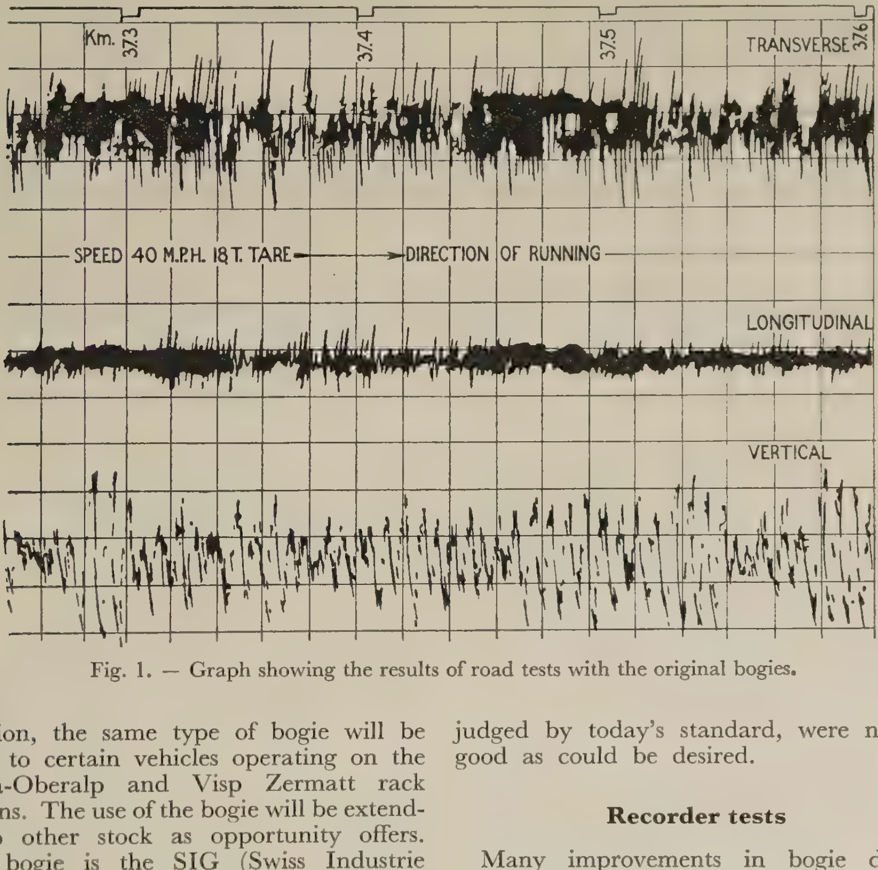


Fig. 1. — Graph showing the results of road tests with the original bogies.

In addition to its modern rolling stock the Rhaetian Railway has in service a number of carriages built before 1930, and while they were in such condition as to warrant their being retained in service for a number of years, their riding qualities, judged by today's standard, were not as good as could be desired.

Recorder tests

Many improvements in bogie design to provide improved riding qualities have been carried out in recent years, and before coming to a definite decision, the railway preferred not to base their requirements on assumptions, or superficial observations. Consequently some 12 months ago the first steps were taken by using a three-component acceleration recorder to study the running characteristics of a second and third class composite bogie carriage, which, with other carriages of similar design, were intended to be provided with new equipment to improve their riding qualities.

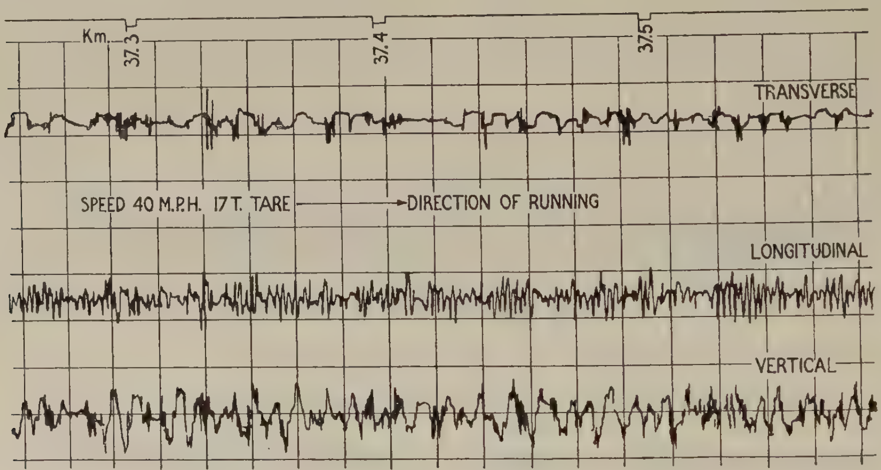


Fig. 2. — Results of road tests with the new SIG torsion-bar bogies on metre-gauge track.

The results of the road tests on the original bogies are given in figure 1, which shows considerable transverse and vertical movement at speeds up to 40 m.p.h. The railway has had considerable experience with the SIG torsion-bar type bogies which are fitted on eight of the railway's lightweight trailer cars. Two bogies of this type were specially ordered for the purpose of carrying out road tests, the results of which are shown in figure 2.

The axles are fitted with roller-bearing axleboxes and support the bogie frame through four square-section coil springs; oil-operated shock absorbers are also fitted; this is the design now usually fitted to Swiss coaches. On the centre-line of the frame there is a bolster suspended on inclined links. The bolster is itself sprung vertically through the action of two transverse torsion bars.

The carriage body is carried on two laterally placed oil-lubricated surfaces, while the bogie centre pin has only to deal with transverse and longitudinal forces, working freely on the vertical plane. The bolster itself is connected with the bogie frame in the longitudinal direction by two links, and its frame supports the brake shoes, two on each wheel. One bogie on each carriage has a bracket extending towards the centre for supporting the dynamo.

Test results

No difficulty was experienced in the fitting of the new bogies, and the first texts were carried out in February last. From the results given in the diagram, it will be seen that transverse oscillations have been reduced considerably when compared to that experienced with the original bogies. Longitudinal movement is little influenced by the type of bogie, and this was slightly reduced. Tare weight of the cars is approximately one *tonne* less than the original weight. The Rhaetian Railway has ordered 18 more bogies of the

SIG torsion-bar type, and its use will be gradually extended, a significant move, for this railway took some of the very first prototypes of the torsion-bar bogie, and has had 16 in service since 1938.

Though many of the SIG torsion-bar bogies are on narrow-gauge passenger stock — the sharply-curved Brünig section of the Swiss Federal Railways alone has 142 of them running — many others are used on standard-gauge coaches running day by day up to 75 m.p.h., not only with steel-tyred coaches, but with pneumatic-tyred Michelines also. Running tests up to 95 m.p.h. have been undertaken in France.

[625 .245 (45)]

New ore hopper in light alloys for the transport of coal.(*)

The experimental Institute for Light Metals (I. S. M. L.) in Milan has studied and produced an ore hopper of light alloy in order to show that aluminium, besides the advantage it has due to its lesser weight, also avoids the defects due to corrosion which affect the material in steel wagons. It is known that the sulphur in coal attacks the steel strongly, whereas it has no particular effect on aluminium and its alloys. Even the effect of coating the steel with varnish, which is sometimes applied to standard wagons, does not get over the difficulty since the coating of varnish will not resist the abrasive action of the coal.

Leaving aside timber on account of its small strength, aluminium is, thanks to its properties, the most suitable material for these purposes.

Although the cost of aluminium is higher than that of steel, we secure a saving by the use of light alloys due to a reduction in the dead weight (and the correlative possibility to increase the pay load) as well as in maintenance costs.

A wagon of this type, with two axles, should not weigh more than 32 tons, including the load. On the basis of this figure, the Technical Office of the Research Department in the I. S. M. L. has elaborated a design for an ore hopper made of light alloy with four compartments which in comparison with a standard steel wagon has an increased carrying capacity of about 35 % while the tare is reduced by 25 %.

While the steel wagon has a capacity of 19 m^3 (671 cub. ft.), 25.5 m^3 (883 cub. ft.) has been obtained in the case of the experimental wagon of light alloy, so that the pay load has changed from 17 000 kg to 23 000 kg from (16.73 to 22.63 tons). Since the tare is 8 900 kg against 12 000 kg (8.78 tons against 11.81 tons) for the steel wagon, it follows that a wagon made of light alloy will carry 390 kg (860 lbs.) of dead weight per ton of pay load, whereas with the steel wagon, for the same pay load it would be necessary to carry at least 705 kg (1 554 lbs.) of dead weight.

In addition, this proposal is based on an entirely new idea : the wagon is self-supporting as is the case with the coachwork of certain motor cars and the fuselages of aircraft. Provision for unloading the coal consists of four swing doors opening in both directions; when they are opened, the coal slides automatically down the slopes at the bottom of the hopper. This bottom of the hopper forms the dorsal fin of the wagon and acts as a girder having a high moment of inertia, sufficing to ensure rigidity of the vehicle. Since it was necessary to fix the plate springs on this triangular girder, made up of plates, it became necessary to strengthen the parts concerned by fastening them to a channel iron ⊏, likewise rolled in light alloy.

In order not to spoil their appearance, these two spars or longerons were left continuous over the whole length of the wagon, although they would not actually be needed as stiffeners to that extent.

In the tare of 8 900 kg (8.78 tons) are included 4 970 kg (4.82 tons) of aluminium and 3 930 kg (3.86 tons) of steel. The chassis and hoppers are in rolled sections and plates of anticorrodal alloy II with heat treatment. The same alloy has been

---

(*) Note received from the *Istituto Sperimentale dei Metalli Leggeri* (Milan).

Characteristics of the light alloy wagon compared with those of a similar truck made of steel.

Type of truck	Tare t	Capacity m³	Load t	Ratio tare/capacity kg/m³	Ratio tare/load kg/t
In aluminium alloy . .	8.9	25.5	23	350	390
In standard steel . . .	12.0	19.0	17	630	705

used for buffers, for the levers controlling the swinging doors and for certain forgings. The brakeman's cab is fitted with a frame of anticorrodal, whilst the ceiling and the roof which are less severely stressed, are made of pure aluminium. The traction rod is made of Ergal 65 alloy suitable for high tensile stress to which this important part is exposed. The equally important axle box guides are likewise formed of plates and rolled sections of anticorrodal. The axleboxes have bodies formed of « Duralite » aluminium cast in sand and tempered. The joints were made with rivets of anticorrodal, left semi-hard so that the heads could be riveted over.

Joints were in some cases lined with mastics such as « Enduit Georget » and « Bituplastic ». On the order hand, the axles and gears for the Breda-Westinghouse-Galante brake equipment are made in steel, as well as the traction hook and various other secondary parts, which could in future be made of aluminium alloy.

The running gear was enameled in black, but the parts of light alloy were left unprotected.

The wagon was built at the « Officine di Pomigliano per Costruzioni Aeronautiche e Ferroviarie » (A. E. R. F. E. R.), which has the tools required for machining light alloys. The light alloys were supplied by the « Soc. Lavorazione Leghe Leggere » (L. L. L.), Venice, whose agent is « Alluminio S. p. A. (A. S. A.), Milan.

The rivets were supplied by the firm of Baraldi, Milan, and the fittings by Internave of Genoa and Guastalla of Milan.

The wagon was put into service in 1953 with the « Cokapuania Company » of Milan.

Average mechanical characteristics of the light alloys used in the hopper wagon.

ALLOY	Breaking stress kg/mm²	Elastic limit kg/mm²	Elongation %	Brinell hardness kg/mm²
Anticorrodal (heat treated)	34	27	12	100
Ergal (heat treated)	70	64	7	180
Duralite (sandcast, heat treated) . . .	33	26	2	125

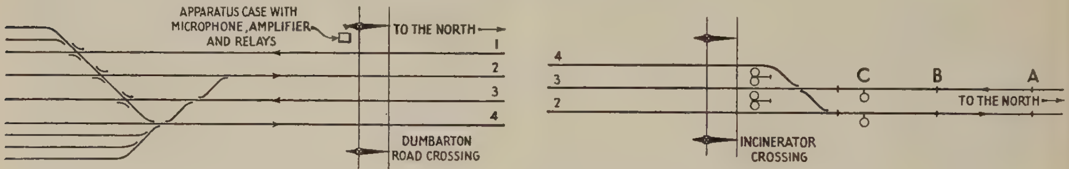
[625 .162 (73)]

Whistle and radio control of level crossing gates.

Installations on important connecting railway lines in the East and South of U.S.A.

(*The Railway Gazette*, February 4, 1955.)

Control of level crossing barrier gates by engine whistle and radio has been introduced on the Richmond, Fredericksburg & Potomac Railroad. This system has 115 miles of double-track main line from Richmond, Virginia, north to the Potomac river at Washington. Besides its own trains, R. F. & P. train crews and locomotives work through passenger trains on routes between New York and Georgia, Alabama, and Florida, connecting with the Pennsylvania and Baltimore & Ohio at Washington and with the Atlantic Coast Line and the Seaboard Air Line at Richmond. Local and through freight also is handled. Train speeds average 80 m.p.h. for passenger trains and 50 m.p.h. for freight.



Layouts at four-track crossing at Dumbarton, Richmond (left), and at Incinerator crossing, Quantuo, R. F. & P. RR.

On some parts of the railway trains are signalled for movements in both directions over the same track. The controls of all level crossing gates are also arranged for train movements in both directions. If a train is stopped or delayed on a section for more than 2 1/2 min., the level crossing barriers will raise automatically to permit highway vehicles to pass, which required arrangements for the barriers to be lowered again when trains are ready to proceed on their journey.

This could have been done by the use of track circuits; but the railway already has coded track circuits in use and cab signalling and the insertion of additional track circuits would have been expensive. The alternative scheme developed permits enginemen to have a more positive control over the gates.

Four-track crossing.

A typical level crossing is at Dumbarton, 1/4-mile north of the freight yard at Richmond where four main tracks are concerned. When shunting is taking place at the north end of the yard the engine works on No. 1 track and occupies the approach controls for the crossing protection setting the flashing lights into operation and lowering the gates. In nearly all cases the engine stops short of the gates and shunts back into the yard.

Timing circuits are provided at the gate interlocking installation which cuts out the flashing red lights and opens the gates after an interval of 2 1/2 min. The gates would, of course, again be automatically closed if trains approached on other tracks.

Should the shunting engine wish to move over the crossing, the driver blows his whistle. The sound reacts on a conventional carbon telephone transmitter mounted at the level crossing. This transmitter feeds through an amplifier to pick up a relay where, ordinarily, a loud speaker would be connected. This relay controls circuits which bring the flashing light into action and lowers the barriers in the same manner as though the controlling track circuits had become occupied. The whistle amplifier is so adjusted as to operate on a definite volume of sound and it will not respond to the horns of passing cars.

Using radio on locomotives.

A similar installation was intended for Quantuo, Virginia, but as it is near an aerodrome the amplifier responded to noise from aeroplanes. As an alternative it was decided to make use of the radio on the locomotives. The layout is shown in the right-hand diagram.

Located between the tracks, slightly north of Incinerator crossing, are two ground indicators having lunar white lenses facing both ways. They are normally out. When an approaching train or shunting engine occupies one of the control track circuits, the flashing lights and barrier gates are occupied. If the train or engine, stops short of the crossing, after an interval of 2 1/2 min., the lunar white lights are displayed and 20 sec. later the barrier is lifted.

The lunar white lights indicate to drivers that the crossing is open and action must be taken before they again move forward. This is done by pressing a special button in the engine cab and this puts the locomotive radio on the air. The signal is picked up by a short range receiver at the crossing which relays it to the amplifier. Following this the action is the same as though the engine whistle signal had been received.

The radio also acts as a directional control where engines have shunted over the crossing and wish to return. The pressing of the button releases certain relays and closes the barriers. Special arrangements are made for heavy road traffic by the use of a push button and lever housed in a box at the crossing. The box is locked up.

The manual control can be used for lowering the gates at any time but it can only be used for lifting the gates when one of the short track circuits at the level crossing have failed. In this case it is necessary to push the button and operate the lever at the side This action has to be maintained otherwise, if lever and button are released, the gates will close.

The installation also includes selective speed control. On a southbound train passing point A, a time measuring circuit is brought into operation which is set to provide 25 sec. warning at 80 m.p.h.

If point B is reached before the time circuit has completed the cycle, the average speed of the train is above 50 m.p.h. and the crossing protection will be controlled by the high-speed circuit (80 m.p.h.). If the timing circuit cycle is completed before train reaches point B, indicating train speed below 50 m.p.h., the start of the crossing protection is delayed until point C is reached which provides 25 sec. warning at 50 m.p.h.

The R. F. & P. RR. uses coded track circuits for track and cab signals and to avoid the expense of inserting too many short track circuits for crossing protection, treadles are used. as can be seen in the diagram of the crossing at Quantuo.

NEW BOOKS AND PUBLICATIONS.

[**625** .28]

Dieselfahrzeuge im Schienenverkehr. Eine vergleichende Betrachtung gegenüber Dampf- und elektrischer Zugförderung. *(Diesel vehicles in railway traffic. Comparison with steam and electric traction.)*. Report by the Labour Community « Diesel transport on rail ». — One volume (8 1/4 × 11 3/4 inches), cloth bound, of 168 pages, with 63 figures and 35 tables. — 1954, Carl Rohrig — Verlag oHG, Stephanstrasse 8, Darmstadt. (Price : D.M. 15.00).

Steam traction long remained the undisputed master of the railway field. In spite of successive improvements which raised the output of the locomotive and increased its power to figures undreamt of at the beginning of the century, a formidable competitor, electric traction has come into being. This latter has already won a considerable field and new extensions are planned or in course of realisation.

But a new competitior has arised in the shape of Diesel traction. After having ousted steam from the orders of the great railways in North America, it is threatening to act as a checkmate to new developments of electric traction. On the old Continent, its applications tend to become more numerous, both for trains services and shunting services. It is also gaining ground in the colonies.

On railways where steam is still widely used, which have not yet definitely decided in favour of a new method of traction, a thorough study of the characteristics of these three competitors, of their advantages and drawbacks, cannot fail to be of the greatest interest. This is the object of the studies undertaken by the Labour Community « Diesel traction on the railway ».

An introductory note explains why the Labour Community was set up and defines its objects.

The first chapter describes the present position of Diesel traction in the world.

The second analyses the sources of power available to the railways and goes into the technical and economic conditions under which they can be utilised.

Under the title « Position of the development of rail motor vehicles », the third chapter gives the actual characteristics of each of these three methods of traction together with their present tendencies.

In the fourth chapter, the authors suggest a way of estimating the capital costs involved in changing over from steam to electric or Diesel traction.

The fifth chapter is devoted to a determination of the traction costs under various hypotheses. The results given by the various applications already made are quoted. The way in which these new methods of traction can increase the capacity of lines is also shown.

The sixth chapter deals with the influence of changing over from steam to Diesel traction on the construction and running of the service shops and main repair shops.

A short note calls attention to the benefits experienced by the permanent way maintenance department when Diesel vehicles are substituted for steam engines.

In the last chapter, the authors stress the various advantages of Diesel traction from the point of view of the organisation of the train services and the suppression of the various disadvantages attaching to steam traction.

A final note : « General results of the investigations » briefly gives the conclusions arrived at on the various points dealt with in the body of the work.

E. M.

[**385** (09 .3 (481)]

Vårt Yrke. Jubileumsnummer 1854. — Hundre Ar — 1954. *(Our Profession. Jubilee Number. One hundred years,* 1854-1954*).* — One brochure (8 1/4 × 11 3/4 inches) of 48 pages, copiously illustrated. — 1954, Oslo, Norges Statsbaner, Storgatan, 33.

The Norwegian State Railways celebrated, in September last year, the centenary of the opening of their first railway line which linked the capital with Eidsvoll, a town 68 km (42 miles) away.

To celebrate the occasion, a railway exhibition was organised in Oslo and an exhibition train made a circular tour of the country. An ancient locomotive, built in 1861, was put back into service and used to transport visitors to the exhibition.

The review *Vårt Yrke (Our Profession),* which is published by the Norwegian State Railways, and is six years old, issued this special number to commemorate the 100th birthday of the railway.

The evolution of the railway from 1850 to our own days has been presented by the authors essentially pictorially.

Drawings, accompanied by legends or notes, show the most diverse subjects. There are phogravures of celebrated persons, ancient documents, views of the original stations, picturesque scenes, bridges, track equipment, rolling stock, signal boxes.

The first pages bring back the heroic age of the pioneers. Then we are shown civil engineering works which obviously had to overcome great obstacles.

The gallery of the rolling stock shows the oldest and the most up to date models.

The transport of freight and the equipment of the stations is another field open to the ingenuity of the operator.

Views showing the activities of the staff and the work done on their behalf add to the illustrations.

This document in an attractive form, making use of contrasts, is an eloquent testimony to the work of modernisation accomplished during recent years.

E. M.

[**313** : 656 (494)]

Schweizerische Verkehrsstatistik. *(Swiss Transport Statistics.)* Published by the *Federal Transport Office.* One volume (8 1/4 × 11 1/2 in.) of 176 pages and 10 diagrams (Price : 12 Swiss fr.)

The statistics included is this volume are intended to form a basis for the appreciation of the part played by the various methods of transport in the country.

The sixth volume of this sort to appear under this title, it has kept to the same general format. However, various additions and improvements have been made that increase its usefulness.

Thus the data relating to road transport have been improved by several additions and the tables dealing with this subject have been rearranged. More detailed data have been collected about the bus services.

Owing to the very nature of the railway, the statistics covering this method of transport, which are most extensive, are more or less stabilized.

On the Federal Railways, the passenger traffic has fallen slightly, whereas freight traffic has remained more or less stationary. Receipts have improved owing to increases in the rates which came into force on the 1st April 1953. Costs have also risen, so that the operating coefficient has risen slightly whilst remaining favourable, 72 % as compared with 71.1 % in 1952.

As a whole the private railways with general traffic have continued to prosper but to a slightly lesser degree, owing to the motor competition from which small railways suffer particularly.

On the other hand, the rack railways, the funiculars and telpher lines have shown new progress.

The buses and trolleybuses, in urban undertakings, show an appreciable increase in their receipts.

Interesting from more than one point of view are the statistics for road traffic. The striking fact is the further increase in the number of vehicles on the roads.

But it is air traffic which shows the greatest improvement of all methods of transport, since 1946. There has been an increase both on the Swiss lines and in foreign lines into Switzerland.

E. M.

MONTHLY BIBLIOGRAPHY OF RAILWAYS (1)

PUBLISHED UNDER THE SUPERVISION OF

P. GHILAIN,

General Secretary of the Permanent Commission of the International Railway Congress Association.

(AUGUST 1955)

[016. 385 (02]

I. — BOOKS.

In French.

1955 621 .89

AZAUD (R.).

Le frottement et l'usure des métaux. Les antifrictions.

Paris, Dunod, éditeur. Un volume relié (16 × 25 cm) 234 pages, avec 156 figures. (Prix : 2 250 fr. fr.)

1955 62 (01

ELACHET (A.).

La résistance des matériaux.

Paris, Presses Universitaires de France — Collection Que sais-je ? ». Un volume de 127 pages, avec 30 figures. rix : 144 fr. fr.)

1955 691

UPFER (G.).

La pratique du coffrage en bois et du ferraillage.

Adapté et présenté par L. BOURGINE. Tome II.

Paris, Eyrolles, éditeur. Un volume (19×27 cm) de 28 pages, avec 135 figures. (Prix : 950 fr.fr.)

1955 62 (02

Notes et formules de l'Ingénieur *(Formulaire de aharpe)*. 23e édition entièrement refondue sous la rection de MM. M. DENIS-PAPIN et J. VALLOT. Tome IV.

Paris, Albin Michel, éditeur, 22, rue Huyghens. Un olume (12 × 19 cm) de 1936 pages, avec 1470 figures. rix : 5 945 fr. fr.)

1955 385 (08 (493)

OCIÉTÉ NATIONALE DES CHEMINS DE FER VICINAUX.

Rapports présentés par le Conseil d'Administration et r le Comité de Surveillance. Soixante-dixième exercice cial (1954).

Bruxelles, Imprimerie Graphica, 54, rue Auguste ambiotte. Une brochure (22,5 × 30,5 cm) de 44 pages, ec de nombreux tableaux et illustrations.

1955 656 (4 + 6)

NION INTERNATIONALE DES CHEMINS DE FER.

Concurrence et coopération entre chemin de fer et tomobile en trafic intérieur et en trafic international yageurs et marchandises. Projet de rapport des Chemins fer fédéraux suisses pour l'année 1954.

Paris, publié par l'U.I.C., 10, rue de Prony. Une ochure (21 × 30 cm) de 42 pages.

In German.

1955 656

BRAND (L.).

Schiene und Strasse, Jahrbuch 1954.

Dortmund. Verkehrs- und Wirtschaftsverlag Gmbh. 143 Textseiten, DIN A 4. (Preis : D.M. 6.—)

1954 625 .15

DROSZIO (L.).

Weichen und Kreuzungen. *Oberstufe.*

Leipzig, herausgegeben von der Lehrmittelstelle der Deutschen Reichsbahn. Fachbuchverlag. 80 Seiten, DIN A 5 mit 79 Bildern. (Preis : 4.80 D.M.)

1955 624

KOCH.

Brückenbau. Teil I : *Planung von Brücken, Lastannahmen, Massivbrücken nebst Berechnungsgrundlagen.*

Leipzig, Teubner Verlagsgesellschaft m.b.H. 330 Seiten mit 52 Tafeln und 306 Bildern. DIN C.5. (Preis : kartoniert, 24.40 D.M.; Halbleinen, 26.80 D.M.)

1954 621 .3 (43)

RADDE (R.).

Technische Berechnungen für den maschinen- und elektrotechnischen Dienst bei der Deutschen Eisenbahn. 4. Auflage.

Berlin-Lichterfelde, Verlag Georg Achterberg. 216 Seiten, DIN A 5. (Preis : brosch. D.M. 10.-)

1954 62 (03 : 656 .25

Dr.-Ing. habil. W. SCHMITZ.

Englisches Wörterbuch für Eisenbahn-Signalwesen und Fernmeldetechnik. 2. verbesserte Auflage. Deutsch-Englisch & Englisch-Deutsch.

Frankfurt a. M., Dr. Arthur Tetzlaff-Verlag, Niddastrasse 64. 2 Bände geb. Ln. (11.5 × 17 cm) von 202 und 246 Seiten.

In English.

1955 62

BIEZENO (C.B.) and GRAMMEL (R.).

Engineering dynamics. *Volume III :* **Steam turbines;** *Volume IV :* **Internal combustion engines.**

Blackie and Son, Limited, 17, Stanhope-street, Glasgow, C.4 (Volume III, 40 s.; volume IV, 50 s.)

---

(1) The numbers placed over the title of each book are those of the decimal classification proposed by the Railway Congress njointly with the Office Bibliographique International, of Brussels, (See « Bibliographical Decimal Classification as applied to Railway ience », by L. WEISSENBRUCH, in the number for November 1897, of the *Bulletin of the International Railway Congress*, p. 1509.)

1955 **621** .33
BINNEY (E. A.).
Electric traction engineering.
London : Cleaver-Hume Press, Ltd., 31, Wright's Lane, Kensington, W. 8. (Price : 15 s.)

1955 **656** .237 (73)
BUNNELL (E.H.).
Railroad accounting and statistics.
One volume (6 1/2 × 9 1/2 inches) of 272 pages, illustrated.
Chicago 6 : Watson Publications, Publishers of Modern Railroads, 201, N. Wells St. (Price : 6 $.)

1955 **621** .438
Sir HAROLD ROXBEE COX.
Gas turbine principles and practice.
London : Georges Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2 (Price : £ 4.10.0 d.)

1955 **621** .438
HODGE (J.).
Gas turbine series : *Vol. I.* Cycles and performance estimation.
London : Butterworth's Scientific Publication, 88, Kingsway, W.C. 2. (Price : £ 2. 10.0 d.)

1955 **62** (0
LESSELLS (J.M.)
Strength and resistance of metals.
One volume 450 pages, 8vo. New York : John Wile and Sons, Inc.; London : Chapman and Hall, Ltd. (Price : 80 s.)

1955
SHERWOOD TAYLOR (F.).
Power to-day and to-morrow.
Published by Frederick Muller, Ltd., Ludgate Hous 110 Fleet Street, London, E.C.4. 187 pages (× 5 1/2 in).
(Price : 15 s. net.)

1955 **656** .2
Report on the collision which occurred on November 1 1954, at Betley Road between Stafford and Crewe i the London Midland Region. British Railways.
Ministry of Transport and Civil Aviation, Railwa Accidents. H. M. Stationery Office, Kingsway, Londo W.C. 2 (6 d.)

1955 **5**
VER PLANCK (D.W.) and TEARE (B.R.).
Engineering analysis : An introduction to professiona method. London : Chapman and Hall Limited, 3 Essex Street, W.C. 2. (Price : 48 s.)

[**016.** 385 (05]

II. — PERIODICALS.

In French.

Acier - Stahl - Steel. (Bruxelles.)

1955 **669** .1
Acier — Stahl — Steel, Mars, p. 127.
DUTHEIL (J.). — L'évolution des **règles d'utilisation de l'acier.** (5 000 mots & fig.)

1955 **624** .8 (485)
Acier — Stahl — Steel, Avril, p. 159.
EWERDAHL (S.). — Le **nouveau pont de Hjulsta** en Suède. (800 mots & fig.)

1955 **62** (01 & **669**
Acier — Stahl — Steel, Avril, p. 173 & 178.
HEBRANT (F.) et DEMOL (L.). — **Essais de traction simple sur des profilés courants en acier A 37.** (2 300 mots, tableaux & fig.)
HEBRANT (F.) et DEMOL (L.). — **Essais de traction sur des assemblages rivés de profilés en acier A 37.** (2 500 mots & fig.)

Annales des Travaux Publics de Belgique. (Bruxelles.)

1954 **624** .2 (493)
Ann. des Trav. publics de Belgique, décembre, p. 843.
BIRGUER (A.). — **Poutre continue précontrainte à deux travées.** Pont de Dinant sur la Meuse. (5 000 mots, tableaux & fig.)

Bulletin des C.F.F. (Berne.)

1955 **656** (49
Bulletin des C.F.F., Avril, p. 55.
Une **collaboration rail-route** effective. Les transpor d'automobiles par le Saint-Gothard. (800 mots & fig.)

1955 **625** .26 (49
Bulletin des C.F.F., Avril, p. 61.
LILLJEQVIST (H.). — **L'entretien des wagons** au ateliers d'Yverdon. (1 200 mots & fig.)

Bulletin de Documentation S.C.E.T.A. (Paris

1955 **621** .1
Bulletin de Documentation S.C.E.T.A., mars-avril, p.
Les huiles de graissage et l'usure des moteurs. (3 0 mots & tableaux.)

1955 **656** .1 (44) & **656** .2 (4
Bulletin de Documentation S.C.E.T.A., mai, p. 1.
Rôle du G.T.T.M. et de la Société SOFRAMIXT dans l'**organisation du transport mixte rail-route.** (1 5 mots & tableaux.)

Bulletin de la Société des Ingénieurs civils de France. (Paris.)

1955 **669**
Bulletin de la Soc. des Ing. Civ. de France, fascicule janvier-février (mémoires), p. 10.
DEDIEU (J.). — **Evolution des aciers inoxydabl et de leur emploi.** (6 000 mots & fig.)

Chemins de fer. (Paris.)

1955 **656** .222 .1 (44)
Chemins de fer, mars-avril, p. 25.
CAIRE (D.). — Le **Ruban bleu du Rail. Deux locomotives électriques françaises atteignent 331 km/h**, Lamotte-Morcenx, les 28 et 29 mars 1955. (2 000 mots & fig.)

1955 **656** .222.5 (44)
Chemins de fer, mars-avril, p. 31.
CAIRE (D.). — Les **horaires du service voyageurs** de la S.N.C.F. en mai 1955. (3 000 mots, tableaux & fig.)

1955 **621** .33 (44)
Chemins de fer, mars-avril, p. 45.
CAIRE (D.). — La mise en service de l'**électrification** sur Mâcon-Bourg-Ambérieu. (1 500 mots & fig.)

1955 **621** .335 (44) & **625** .26 (44)
Chemins de fer, mars-avril, p. 48.
SCHERER (L.). — Après 15 ans de service. **Réparations et modifications des caisses en acier inoxydable des automotrices 1 500 V., dites « Budd »** de la banlieue Ouest. (3 000 mots & fig.)

Génie Civil. (Paris.)

1955 **624** .5
Génie Civil, nº 3393, 15 mars, p. 104.
La résistance des ponts suspendus aux efforts résultant du vent. (2 500 mots & fig.)

1955 **625** .13 (42)
Génie Civil, nº 3393, 15 mars, p. 113.
Le nouveau tunnel de Woodhead sur la ligne de Manchester à Sheffield, des British Railways. (1 000 mots & fig.)

1955 **62** (01
Génie Civil, nº 3395, 15 avril, p. 149.
MASSE (R.). — **Calcul de la déformation d'éléments à sections variables.** (1 500 mots & fig.)

1955 **62** (01
Génie Civil, nº 3396, 1er mai, p. 167.
COÜARD (A.). — Les récentes expériences américaines sur **l'effort tranchant.** (1 500 mots, tableau & fig.)

1955 **621** .33 : **625** .3 (44)
Génie Civil, nº 3396, 1er mai, p. 173.
L'électrification en courant monophasé à 50 Hz du chemin de fer à crémaillère du Montenvers. (1 000 mots & fig.)

L'Industrie des Voies Ferrées et des Transports Automobiles. (Paris.)

1955 **624** .8 (44)
L'Industrie des Voies Ferrées et des Transports Automobiles, mars, p. 37.
MÉDALIA (A.). — Le **pont-levant** de Recouvrance Brest. (2 300 mots & fig.)

Industries et Sciences. (Rhode-St. Genèse lez-Bruxelles.)

1955 **625** .13 (44 + 45)
Industries et Sciences, nº 1, mars, p. 13.
BECHET (F.). — Le **tunnel routier sous le Mont-Blanc.** (1 500 mots & fig.)

Revue Belge des Transports. (Bruxelles.)

1955 **621** .431 .72 (493)
Revue Belge des Transports, nº 1, p. 43.
BOULANGER (S.). — Les **nouvelles locomotives Diesel-électriques** de la S.N.C.B. (10 000 mots & fig.)

1955 **621** .335 (493)
Revue Belge des Transports, nº 1, p. 75.
BAEYENS (F.). — Les **locomotives BB type 122** de la S.N.C.B. (2 000 mots & fig.)

1955 **621** .335
Revue Belge des Transports, nº 1, p. 81.
DISPAUX. — **L'évolution du matériel électrique de grande traction** en Belgique et à l'étranger. (2 500 mots & fig.)

1955 **621** .33 (493)
Revue Belge des Transports, nº 1, p. 93.
Progrès de la traction électrique à la S.N.C.B. en 1954 (1 500 mots & fig.)

Revue Générale des Chemins de fer. (Paris.)

1955 **621** .335 (44)
Revue Générale des Chemins de fer, avril, p. 193.
BODMER (C.), LEYVRAZ (P.) et ANDEREGG (E.). — Les **locomotives CC série 14 000 à groupe convertisseur monotriphasé.** (6 500 mots, tableaux & fig.)

1955 **621** .335 (44)
Revue Générale des Chemins de fer, avril, p. 210.
Résultats d'exploitation des locomotives monophasées du Nord-Est. (1 500 mots, tableaux & fig.)

1955 **625** .143 .3
Revue Générale des Chemins de fer, avril, p. 214.
MONNET & PALMÉ. — L'**usure ondulatoire des rails.** Phénomène à seuil. (3 700 mots & fig.)

1955 **656** .257 (44)
Revue Générale des Chemins de fer, avril, p. 223.
GAILLARD. — Le **Poste IV électrique à télécombinateurs** de la gare de Villeneuve-Saint-Georges. (1 900 mots & fig.)

1955 **656** .211 .5 : **625** .42 (73)
Revue Générale des Chemins de fer, avril, p. 231.
Un **tapis roulant transporteur** pour le Métropolitain de New-York. (600 mots & fig.)

Revue Générale de Mécanique. (Paris.)

1955 **62** (01 & **621** .436

Revue Générale de Mécanique, février, p. 51.

WIENE (P.E.). — **Essais de fatigue sur des pièces de moteur Diesel** de grandeur nature. (4 000 mots & fig.)

1955 **621** .82

Revue Générale de Mécanique, mars, p. 87.

LELOUP (L.). — **Comment réduire la puissance perdue en frottements dans les paliers lisses ?** (4 000 mots, tableaux & fig.)

Les Transports Publics. (Lausanne.)

1955 **656** (43)

Les Transports Publics, mai, p. 5.

L'Allemagne Occidentale et la **coordination des transports.** (1 000 mots.)

Travaux. (Paris.)

1955 **624** (44)

Travaux, avril, p. 355.

La **reconstruction du pont** de Pont-de-l'Arche sur l'Eure et la Basse-Seine. (28 pages & fig.)

La Vie du Rail. (Paris.)

1955 **621** .139 (44), **625** .18 (44) & **625** .27 (44)

La Vie du Rail, 27 mars, p. 3.

FORCE (G.). — Regards sur le **Magasin Général** de Batignolles. (1 000 mots & fig.)

1955 **625** .13 (45 + 494)

La Vie du Rail, 3 avril, p. 3.

GASSMANN (W.). — **Le Tunnel du Simplon a 50 ans.** (2 500 mots & fig.)

1955 **621** .33 : **625** .13 (494)

La Vie du Rail, 17 avril, p. 14.

BONNAZZELLI (B.). — **L'électrification du Tunnel du Simplon** en courant triphasé. (1 000 mots & fig.)

1955 **656** .222.1 (44)

La Vie du Rail, 17 avril, p. 3.

BOULONGNE (J.). — **331 km à l'heure en chemin de fer.** (4 000 mots & fig.)

1955 **385** (09 (62)

La Vie du Rail, 24 avril, p. 3; 1^er^ mai, p. 12.

LARTILLEUX (H.). — **L'Egypte et ses voies ferrées.** (3 000 mots & fig.)

In German.

Die Bundesbahn. (Berlin.)

1955 **625** .285

Die Bundesbahn, Nr. 4, Februar, S. 192.

FRIEDRICH (R.). — **Verbesserung der Wirtschaftlichkeit im Personenverkehr durch mehrgliedrige Leichttriebwagen.** Studie zur Plannung neuer Dieseltriebwagen-Einheiten mittlerer Leistungsfähigkeit. (5 500 Wörter & Abb.)

1955 **656** .231

Die Bundesbahn, Nr. 5, März, S. 221.

GÜNTHER (A.). — **Beförderungssteuer und Preisniveau.** (1 800 Wörter.)

1955 **656** .214

Die Bundesbahn, Nr. 6, März, S. 264.

GÜNTHER (A.). — Die **Rechtslage der auf fremden Gebiet gelegenen Bahnhöfe und Strecken** im deutsch-schweizerischen Grenzverkehr unter besonderer Berücksichtigung des Beförderungsrechts. (6 000 Wörter & Abb.)

Deutsche Eisenbahntechnik. (Berlin.)

1955 **625** .26 (43)

Deutsche Eisenbahntechnik, Februar, S. 47.

REHM (W.). — Die Aufgaben der Technologie zur **Verbesserung der Arbeit in den Reichsbahnausbesserungswerken.** (6 000 Wörter.)

1955 **656** .256

Deutsche Eisenbahntechnik, Februar, S. 53; April, S. 163.

MÜLLER (W.). — Die vorbeugende Unterhaltung der Blockanlagen der Eisenbahn als Mittel zur Bekämpfung der Blockstörungen. (8 000 Wörter, Tabellen & Abb.)

1955 **656** .225 & **656** .261

Deutsche Eisenbahntechnik, Februar, S. 60.

KRAUSE (H.). — **Transportrationalisierung durch Transportbehälter.** (4 000 Wörter, Tabellen & Abb.)

1955 **625** .235 (43)

Deutsche Eisenbahntechnik, Februar, S. 69.

FONTAINE (J.). — **Anstrichmittel, Anstrichtechnik und Anstrichpflege** insbesondere bei der Unterhaltung der Reichsbahn - Fahrzeuge. (6 500 Wörter.)

1955 **625** .113

Deutsche Eisenbahntechnik, Februar, S. 75.

MÜLLER (W.). — **Gleisbogenberichtigung auf der Grundlage des Verfahrens von Nalenz und Höfer.** (6 000 Wörter & Abb.)

Der Eisenbahningenieur. (Frankfurt a. Main.)

1955 **625** .143 .3

Der Eisenbahningenieur, März, S. 57.

KRUG (H.). — **Die ortsfeste Sonderschleifmaschine zum Aufarbeiten von Schienenköpfen.** (3 600 Wörter & Abb.)

1955 **621** .392

Der Eisenbahningenieur, März, S. 64.

RUPPIN (K.). — **Die elektrische Widerstands-Punktschweissung als wirtschaftlicher Energiefaktor im Fahrzeugbau.** (700 Wörter & Abb.)

1955 **625** .113

Der Eisenbahningenieur, März, S. 77.

HELL (H.). — **Über die Pfeilhöhenrechnung bei Vermarkungsprüfungen.** (2 000 Wörter, Tabellen & Abb.)

E.T.R. Eisenbahntechnische Rundschau. (Köln-Darmstadt.)

1955 **625** .285

Eisenbahntechnische Rundschau, März, S. 71.

TASCHINGER (O.). — Ergebnisse in der **Lärmbekämpfung der Brennkraft-Schienenfahrzeuge.** (26 Seiten, Tabellen & Abb.)

1955 **625** .215

Eisenbahntechnische Rundschau, März, S. 101.

PAUL (J.). — **Entwicklung des Reisezugwagen-Drehgestells** in Deutschland. (6 000 Wörter & Abb.)

1955 **625** .2 (0

Eisenbahntechnische Rundschau, April, S. 121.

KREISSIG (E.). — **Elastischer Langträger zur Achslenkung.** (6 000 Wörter & Abb.)

1955 **656** .211 (43)

Eisenbahntechnische Rundschau, April, S. 132.

POHL (L.). — Die **Verlegung des Hauptbahnhofes** in Bochum. (5 000 Wörter & Abb.)

1955 **656** .212 .8

Eisenbahntechnische Rundschau, April, S. 158.

PFISTER (E.). — Die Stahlbetonbrücke im **Gleiswaagenbau.** (1 200 Wörter & Abb.)

1955 **625** .14 & **625** .2

Eisenbahntechnische Rundschau, April, S. 161.

GÖSSL (N.). — **Die Hertzsche Fläche zwischen Rad und Schiene** bei Zugkraftbeaufschlagung und ihre Auswirkung auf die ausnutzbare Haftung. (10 000 Wörter & Abb.)

Elektrische Bahnen. (München.)

1955 **621** .33

Elektrische Bahnen, April, S. 73.

EBELING (H.). — **Elektrische Zugförderung mit Ignitrongleichrichtern.** (2 500 Wörter & Abb.)

1955 **621** .332

Elektrische Bahnen, April, S. 79.

HAUSMAN (L.). — Einige praktische Formeln zum Verständnis des **Fahr- und Fernleitungsbaues.** (5 000 Wörter & Abb.)

1955 **621** .335 (43)

Elektrische Bahnen, April, S. 88.

WOHLFROM (W.). — **Neue Triebwagen** der Deutschen Bundesbahn, Baureihe ET 56. (4 000 Wörter & Abb.)

Glasers Annalen. (Berlin.)

1955 **621** .431 .72 (81)

Glasers Annalen, Februar, S. 27.

GASSMANN (H.). — **Dreiachsige Henschel-Diesellokomotive der Type DH 360.** (3 000 Wörter & Abb.)

1955 **625** .1 (47)

Glasers Annalen, Februar, S. 31.

HÜRLIMANN (W.). — **Die festen Anlagen der russischen Eisenbahnen.** (2 100 Wörter, Tafeln & Abb.)

1955 **621** .33 (460)

Glasers Annalen, Februar, S. 35.

HAMACHER (F.W.). — **Die Elektrifizierung der spanischen Hauptbahnen.** (3 000 Wörter, Tafeln & Abb.)

1955 **625** .143 .3

Glasers Annalen, Februar, S. 42.

SPADERNA (K.). — **Das Rätsel der Riffeln auf Eisenbahnschienen.** (1 000 Wörter & Abb.)

Internationales Archiv für Verkehrswesen. (Mainz.)

1955 **656** .223 .2 (4)

Int. Archiv. für Verkehrswesen, Nr. 3, 1. Februarheft, S. 49.

KLAER (W.). — **Verkehrsprobleme der Europäischen Gemeinschaft für Kohle und Stahl.** (6 500 Wörter.)

1955 **656** .225 & **656** .261

Int. Archiv. für Verkehrswesen, Nr. 3, 1. Februarheft, S. 57.

SPANG (J.). — **Die rationelle Gestaltung des Haus-Haus-Verkehrs bei der Eisenbahn-Güterbeförderung.** (5 000 Wörter & Abb.)

1955 **388**

Int. Archiv. für Verkehrswesen, Nr. 4, 2. Februarheft, S. 81.

COLBERG (R.). — **Der Weg der öffentlichen Nahverkehrsmittel.** (5 500 Wörter & Abb.)

Der öffentliche Verkehr. (Zürich.)

1955 **656** (494)

Der öffentliche Verkehr, Mai, S. 4.

Zusammenarbeit von Schiene und Strasse am Gotthard. (1 000 Wörter.)

Signal und Draht. (Frankfurt a. Main.)

1955 **656** .253

Signal und Draht, April, S. 53.

GROSSKURTH (K.). — Die **Tragweite von Lichtsignalen** unter besonderer Berücksichtigung des Sehwinkels. (2 000 Wörter & Abb.)

1955 **656** .257

Signal und Draht, Mai, S. 69.

BEHR (E.). — Die **Prüfung von Gleisbildstellwerken.** (5 000 Wörter & Abb.)

1955 **656** .259

Signal und Draht, Mai, S. 77.

LATSCH (A.). — Vorschlag zur **Modernisierung des Platten-Schienenkontakts.** (800 Wörter & Abb.)

Verkehr. (Wien.)

1955 **385 .113 (3)**
Verkehr, Nr. 20, 21. Mai, S. 645; Nr. 21, 28. Mai, S. 673.
HARRAND (G.). — Die **Tätigkeit der Eisenbahnen** in Jahre 1954. (2 000 Wörter.)

In English.

Electrical Engineering. (New York.)

1955 **621 .33 (73)**
Electrical Engineering, May, p. 408.
Ignitron multiple-unit cars for the New Haven Railroad. (3 000 words & figs.)

The Engineer. (London.)

1955 **621 .335 (44)**
The Engineer, April 8, p. 484.
French electric locomotive trials at 205 m.p.h. (1 700 words & figs.)

1955 **621 .431 .72 (42)**
The Engineer, April 15, p. 535.
625 H.P. Diesel-hydraulic locomotives. (1 000 words & figs.)

1955 **625 .172 (42)**
The Engineer, April 22, p. 559.
Weed-killing train. (900 words & figs.)

1955 **621 .438**
The Engineer, April 29, p. 607.
PICARD (F.L.). — **An experimental Turbo-Diesel locomotive.** (4 200 words & figs.)

Engineering. (London.)

1955 **656 .2 (44)**
Engineering, April 22, p. 499.
Modernising French Railways. (1 800 words.)

1955 **625 .144 (42) & 625 .172 (42)**
Engineering, April 22, p. 509.
Weed-killing train for British Railways. — 55 track miles treated in one run. (2 300 words & figs.)

1955 **656 .2 (42)**
Engineering, May 13, p. 584.
Railway modernisation. — *The first stage :* Diesel locomotives and trains, track and installation improvements. (1 200 words & fig.)

Journal and Proceedings of the Institution of Electrical Engineers. (London.)

1955 **621 .33 (42)**
Journal of the Institution of Electrical Engineers, April, p. 222.
Electrification of the Manchester-Sheffield-Wath line. (2 800 words & figs.)

1955 **621 .33 (42)**
Proceedings of the Institution of Electrical Engineers, April, p. 159.
BROUGHALL (J.A.) and COOK (K.J.). — The **electrification of the Manchester-Sheffield-Wath lines,** Eastern and London Midland Regions, British Railways. (28 pages, illustrated)

Journal, The Institution of Locomotive Engineers. (London.)

1954 **621 .431 .72**
Journal, The Institution of Locomotive Engineers, vol. 44 (Part No. 5), p. 545.
FETT (R.H.). — **A modern hydraulic drive for locomotives.** (111 pages, illustrated.)

Journal, The Permanent Way Institution. (London.)

1955 **625**
Journal, The Permanent Way Institution, April, p. 26.
SMITH (G.R.). — **Railway Civil Engineering.** — The present and the future (7 pages.)

1955 **625 .142 .3**
Journal, The Permanent Way Institution, April, p. 33.
HUDSON (J.C.). — **The corrosion of steel sleepers and protective measures for structural steel.** (12 pages, illustrated.)

The Locomotive. (London.)

1955 **625 .231 (42)**
The Locomotive, April, p. 52.
B.R. standard non-gangway coaches. (400 words & figs.)

1955 **625 .213**
The Locomotive, April, p. 53.
Woodhead-Monroe fluid cushion shock absorbers. (1 900 words & figs.)

1955 **621 .431 .72 (54)**
The Locomotive, April, p. 56.
625 H.P. B-B Diesel-hydraulic locomotive for India. (1 500 words & figs.)

1955 **625 .215**
The Locomotive, April, p. 58.
Arbel-Diamond bogies for wagons. (200 words & figs.)

Mechanical Engineering. (New York.)

1955 **625 .28 (73)**
Mechanical Engineering, May, p. 396.
Progress in railway mechanical engineering 1953-1954. (9 pages, illustrated.)

Modern Railroads. (Chicago.)

1955 **621** .335 (73)
Modern Railroads, May, p. 119.
Modern power takes a step ahead. (1 500 words & figs.)

Modern Transport. (London.)

1955 **625** .144 (42) & **625** .172 (42)
Modern Transport, April 23, p. 11.
Weedkilling on railways. (1 800 words & figs.)

1955 **621** .431 .72 (54)
Modern Transport, April 30, p. 5.
Locomotives for India. — Metre gauge Diesel-hydraulic units. (1 400 words & figs.)

1955 **656** .2 (492)
Modern Transport, April 30, p. 19.
DEN HOLLANDER (F.Q.). — **Reconstruction of the railways in Holland** *(to be continued)*. (1 400 words & figs.)

1955 **656** .2 (44)
Modern Transport, May 7, p. 3.
8. — **Train without a crew. — French Railways progress in the use of radio.** (1 200 words.)

The Oil Engine and Gas Turbine. (London.)

1955 **621** .431 .72 (56)
The Oil Engine, May, p. 18.
India's latest locos from Scotland. (1 000 words & figs.)

Railway Age. (New York.)

1955 **656** .25 (73)
Railway Age, March 28, p. 30.
How Santa Fe uses CTC. (1 300 words & figs.)

1955 **625** .244 (73)
Railway Age, March 28, p. 39.
Here's automatic heat or cold. (1 000 words & figs.)

1955 **621** .33 (73)
Railway Age, April 4, p. 40.
WYLIE (L.) & OELHER (A.G.). — **Electrification gets « Vitamins ».** (1 600 words, tables & figs.)

1954 **625** .215 (73)
Railway Age, August 2, p. 24.
LICH (R.L.). — **Truck safety and economy.** How these desiderata are realized today in American passenger car truck design. (1 000 words & figs.)

The Railway Gazette. (London.)

1955 **625** .174
The Railway Gazette, February 25, p. 219.
Clearance of snow and ice. (3 700 words.)

1955 **625** .232 (94)
The Railway Gazette, February 25, p. 223.
Consersation of New South Wales railway passenger stock. (700 words, figs. & tables.)

1955 **656** .2 (47)
The Railway Gazette, March 4, p. 249.
Russian railway developments. (900 words.)

1955 **625** .156 (42)
The Railway Gazette, March 4, p. 251.
Demonstration of hydro-pneumatic buffers. (1 500 words & figs.)

1955 **656** .25 (44)
The Railway Gazette, March 11, p. 277.
Application of electronic devices to track circuiting. (1 400 words & figs.)

1955 **656** .212 (42)
The Railway Gazette, March 18, p. 302.
Mechanised freight yard at Thornton, Fife. (1 200 words & diagrams.)

1955 **621** .335 (68)
The Railway Gazette, March, 18, p. 308.
South African Railways « 4E » locomotives in service. (700 words & figs.)

1955 **621** .33 (944)
The Railway Gazette, March 18, p. 309.
Electrification and quadrupling in New South Wales. (1 900 words & figs.)

Diesel Railway Traction.
A Railway Gazette Publication. (London.)

1955 **621** .431 .72 (494)
Diesel Railway Traction, May, p. 133.
Large locomotives for Switzerland. (5 200 words & figs.)

1955 **621** .431 .72 (42)
Diesel Railway Traction, May, p. 142.
New British Railways standard shunter. (5 000 words & figs.)

1955 **621** .431 .72 (493)
Diesel Railway Traction, May, p. 154.
Belgian main-line locomotives. - II. (2 000 words & figs.)

Railway Locomotives and Cars. (New-York.)

1955 **625** .243 (73)
Railway Locomotives and Cars, May, p. 47.
Lackawanna box cars fitted for modern service. (1 000 words & figs.)

1955 **625** .212 (73)
Railway Locomotives and Cars, May, p. 50.
Here's the AAR, X-2 wheel. (3 000 words & figs.)

1955 621 .33 (73)
Railway Locomotives and Cars, May, p. 57.
WYLIE (L.) and OEHLER (A.G.). — **Old electrification meets all comers.** (2 100 words & figs.)

Railway Steel Topics. (Sheffield.)

1955 625 .143 .3 (8)
Railway Steel Topics, No. 1, p. 14.
O'MAHOMEY (B.M.E.). — **Black spot rail defects on the Rhodesia Railways.** (2 800 words & figs.)

1955 625 .25
Railway Steel Topics, No. 1, p. 21.
BRYAN (E.) and WOODCOCK (J.W.). — **The use of high tensile steel in railway coaching stock.** (3 600 words & figs.)

Railway Track and Structures. (Chicago.)

1955 624 .63 (73) & 691 (73)
Railway Track and Structures, April, p. 35.
First prestressed concrete slab. (1 400 words & figs.)

1955 625 .144 .1 (73)
Railway Track and Structures, May, p. 30.
AREA panel discussion... — 78-ft. rail — Continuous welded rail. (3 000 words.)

1955 624 .7 (73)
Railway Track and Structures, May, p. 39.
RUSSEL (R.B.). — **This all-welded bridge has... built-up stringers-wrought iron deck.** (1 300 words & figs.)

In Spanish.

Ferrocarriles y Tranvias. (Madrid.)

1955 656 .256 : 621 .33
Ferrocarriles y Tranvias, diciembre, p. 414.
GIBERT SALINAS (A.). — **Las conexiones inductivas de impedancia en los circuitos de via para señalización,** establecidos en las lineas electrificadas *(parte II).* (3 500 palabras & fig.)

1955 385 (06 .1 (7+8)
Ferrocarriles y Tranvias, diciembre, p. 425.
El IX Congreso Panamericano de Ferrocarriles (Buenos Aires, 1956). (5 000 palabras.)

In Italian.

Giornale del Genio Civile. (Roma.)

1955 624 .2
Giornale del Genio Civile, marzo-aprile, p. 224.
CONTRI (L.). — La **lastra rettangolare di spessore variabile linearmente nella direzione di una coppia di lati perfettamente incastrata al contorno.** (3 500 parole & fig.)

Ingegneria Ferroviaria. (Roma.)

1955 624 .2
Ingegneria Ferroviaria, aprile, p. 241.
ZANABONI (O.). — **Soluzione abbreviata della trave su suolo elastico.** (4 000 parole & fig.)

1955 656 .256 .3 : 625 .42 (45)
Ingegneria Ferroviaria, aprile, p. 249.
CINI (G.). — **Impianto del blocco automatico sulla Metropolitana di Roma.** (3 000 parole & fig.)

1955 656 .23 (45)
Ingegneria Ferroviaria, aprile, p. 254.
FABRIZI (F.). — **Prodotti ed andamento del traffico** nelle Ferrovie dello Stato. (3 000 parole & prospetti.)

Politica dei Trasporti. (Roma.)

1955 621 .33
Politica dei Trasporti, aprile, p. 200.
SAVOJA (A.). — Il problema del **finanziamento delle elettrificazione ferroviarie.** (4 000 parole.)

1955 656 .2
Politica dei Trasporti, aprile, p. 224.
Direttissima a basse pendenze fra Verona e Monaco. (3 000 parole & fig.)

La Ricerca Scientifica. (Roma.)

1955 691
La Ricerca Scientifica, aprile, p. 864.
PASQUALE D'ELIA. — **Prove di gelività su calcestruzzi confezionati con differenti tipi di cemento.** (5 000 parole & fig.)

Trasporti Pubblici. (Roma.)

1955 621 .33 (44)
Trasporti Pubblici, febbraio, p. 247.
Le **nuove elettromotrici e rismorchiate-pilota per il servizio suburbano** sulla Banlieue Parigina del Sud-Est. (3 500 parole & fig.)

1955 625 .5
Trasporti Pubblici, marzo, p. 361.
D'ARMINI (P.). — La **configurazione delle funi metalliche nel caso particolare delle funivie.** (8 000 parole & fig.)

1955 621 .33 (45)
Trasporti Pubblici, marzo, p. 409.
Un vecchio esperimento delle Ferrovie dello Stato di **trazione elettrica a frequenza industriale.** (1 000 parole & fig.)

1955 625 .42 (71)
Trasporti Pubblici, marzo, p. 421.
La sede e gli impianti fissi della **prima linea metropolitana di Toronto.** (5 000 parole & fig.)

In Netherlands.

De Ingenieur. ('s-Gravenhage.)

1955 **625** .42 (492)
De Ingenieur, nr 9, 4 Maart, p. V. 1.
KEPPLER (F.W.). — Een beschouwing over de mogelijkheid van de aanleg van een ondergrondse stadsspoorweg te Amsterdam. (2 800 woorden & fig.)

1955 **621** .431 .72 (492)
De Ingenieur, nr 11, 18 Maart, p. V. 9.
MOREAU (J.A.E.G.). — **De 850-pk Dieselelectrische locomotieven Serie 2 400 der N.S.** (2 600 woorden & fig.)

1955 **621** .335 (494)
De Ingenieur, nr 11, 18 Maart, p. V. 14.
Mechanisch gedeelte 6 000 pk locomotieven van de Zwitserse Spoorwegen. (1 300 woorden & fig.)

Spoor- en Tramwegen. (Den Haag.)

1955 **656** .213
Spoor- en Tramwegen, nr 7, 31 Maart, p. 97.
FLIPSE (J.L.). — **Spoorverbindingen.** (1 700 woorden & fig.)

1955 **625** .144 .1
Spoor- en Tramwegen, nr 7, 31 Maart, p. 101.
KRABBENDAM (G.). — **Voegloos spoor.** (2 800 woorden).

1955 **385** .62 & **385** .63
Spoor- en Tramwegen, nr 8, 14 April, p. 113; nr 9, 28 April, p. 133; nr 10, 12 Mei, p. 153.
VAN DER MEULEN (J.H.). — De herziening van de **Internationale overeenkomsten betreffende het Vervoer van Goederen en van Reizigers en Bagage per Spoorweg.** (7 000 woorden.)

1955 **625** .42 (492)
Spoor- en Tramwegen, nr 9, 28 April, p. 129.
VAN WITSEN. — De mogelijkheid van **ondergronds vervoer** in Amsterdam. (2 300 woorden & fig.)

1955 **656** .222 .1 (44)
Spoor- en Tramwegen, nr 9, 28 April, p. 140.
NYMEYER (A.G.). — **Nieuwe snelheidsrecords van Franse electrische locomotieven.** (1 000 woorden & fig.)

In Portuguese.

Boletim da C.P. (Lisboa.)

1955 **656** .224
Boletin da C.P., Maio, p. 2.
de ALBUQUERQUE (C.). — A propósito do nosso **tráfego de passageiros.** (2 000 palavras.)

Gazeta dos Caminhos de ferro. (Lisboa.)

1955 **625** .15
Gazeta dos Caminhos de ferro, nº 1614, 16 de Março, p. 7.
PERNES (O.G.). — **Bitolas e disfarces no aparelhos de mudança de via.** (3 500 palavras & fig.)

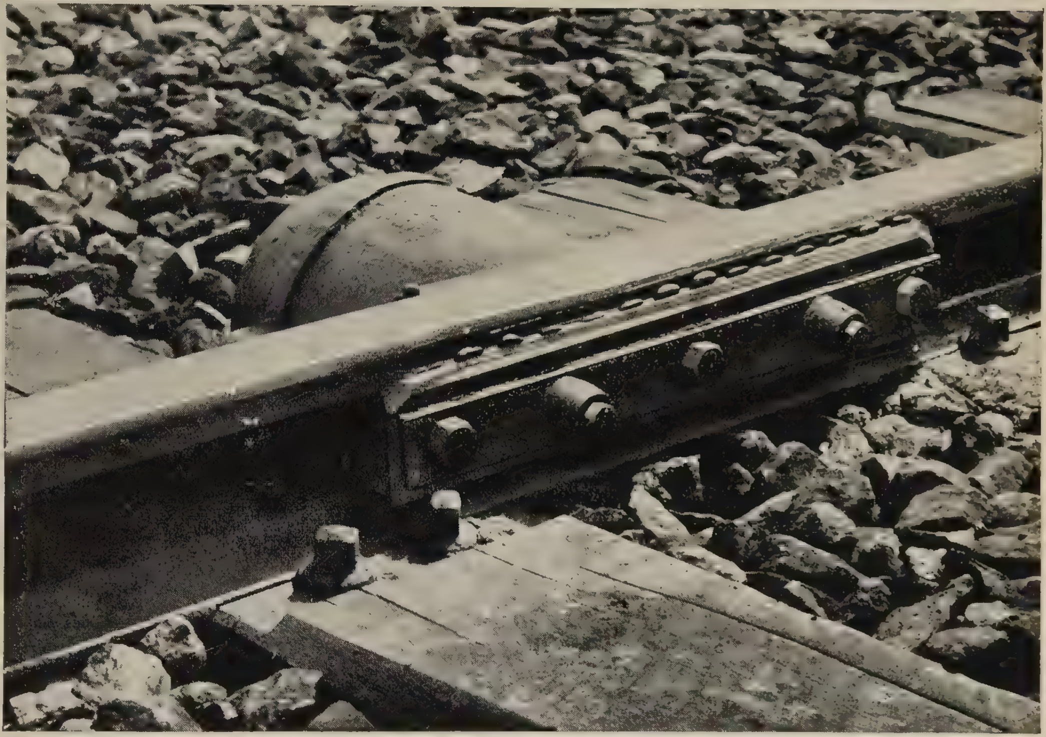
1955 **656** .234
Gazeta dos Caminhos de ferro, nº 1615, 1 de Abril, p. 59; nº 1616, 16 de Abril, p. 75.
TORROAIS VALENTE (R.A.). — Contributo para a **análise qualitativa do tráfego de passageiros** por caminho de ferro. (7 000 palavras & fig.)

Técnica. (Lisboa.)

1955 **691**
Técnica, nº 250, março, p. 327.
DE SOUSA COUTINHO (A.). — **Estudo e controle do betâo no estaleiro.** (14 000 palavras, quadros & fig.)

M. Weissenbruch & Co., Ltd., Printer to the King, 49, rue du Poinçon, Bruxelles.

P. & M.
RAIL & FLANGE LUBRICATORS



Positive acting graphite grease lubricators for running rail and check rail lubrication

Operates efficiently irrespective of speed, axle loads and state of maintenance of Track.

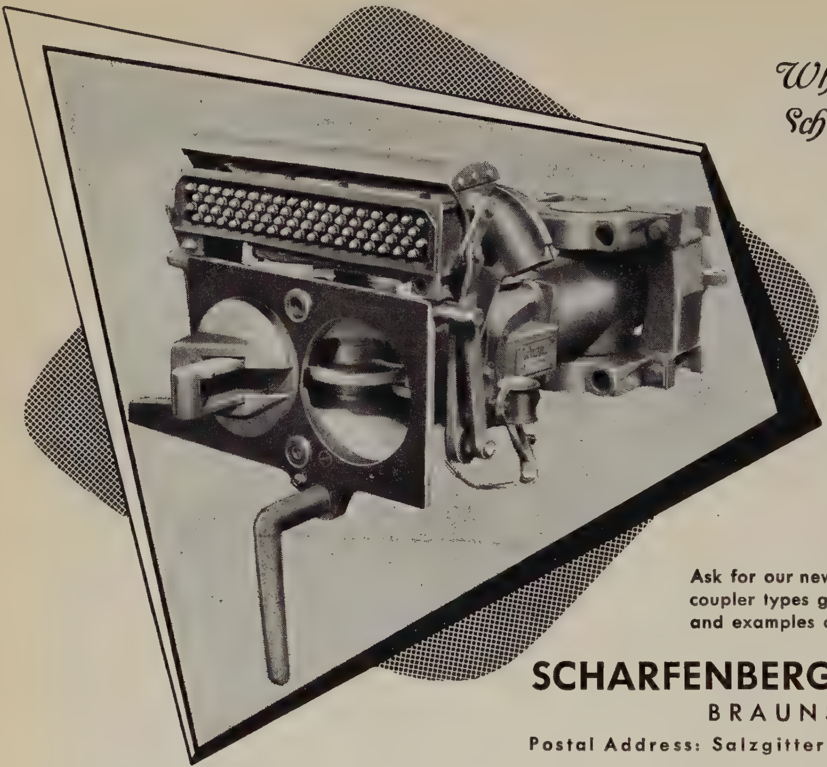
Compact design and sturdy construction ensures long life and minimum maintenance attention.

Absence of external pipes and valves reduces chance of accidental damage or unauthorised interference.

Fully adjustable for varying operating conditions and to provide for vertical wear of rail.

"P. & M." LUBRICATORS are supplied for all rail sections and any type of track construction.

THE **P. & M.** CO.
(ENGLAND) LTD
IA, GROSVENOR GARDENS, LONDON, S.W.I



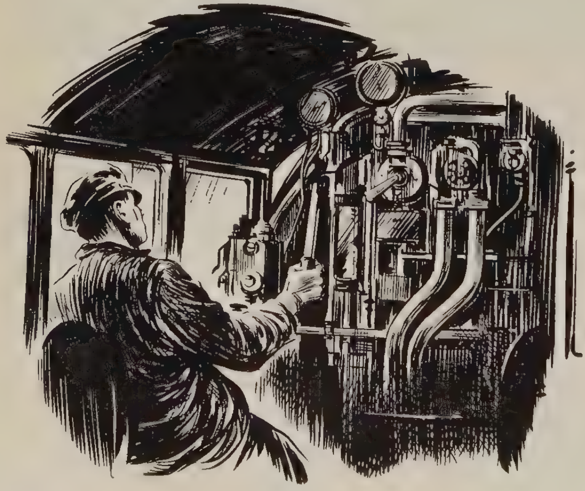
Schaku

Why Scharfenberg Couplings?

- They couple entirely automatically
- They offer a maximum of safety in service
- They prevent accidents and increase profitableness
- They answer all purposes, as many special coupler types are available
- They have been giving satisfaction in service since many years in all parts of the world

Ask for our new catalogue which illustrates our different coupler types giving at the same time technical details and examples of their application to rolling stock

SCHARFENBERGKUPPLUNG GMBH
BRAUNSCHWEIG
Postal Address: Salzgitter-Watenstedt (Western Germany)



Power in hand –

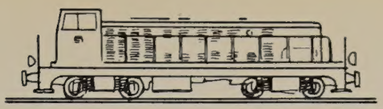
MeLeSco

SUPERHEATERS
MEAN MORE POWER FROM
STEAM

The **SUPERHEATER** Company Ltd

the authority on Superheated Steam

53 HAYMARKET, LONDON, S.W.1. ● Works : TRAFFORD PARK, MANCHESTER, 17



THE TECHNIQUE OF SINTERED PLATES
is confirmed each day in many countries by all
the startings of Diesel locomotives
performed by S. A. F. T. batteries

EACH DAY UNDER ALL CLIMATES
the ruggedness of S.A.F.T. products is demonstrated
by thousands of train lighting batteries in service

SAFT is bringing a new contribution to Rail Exploitation with the

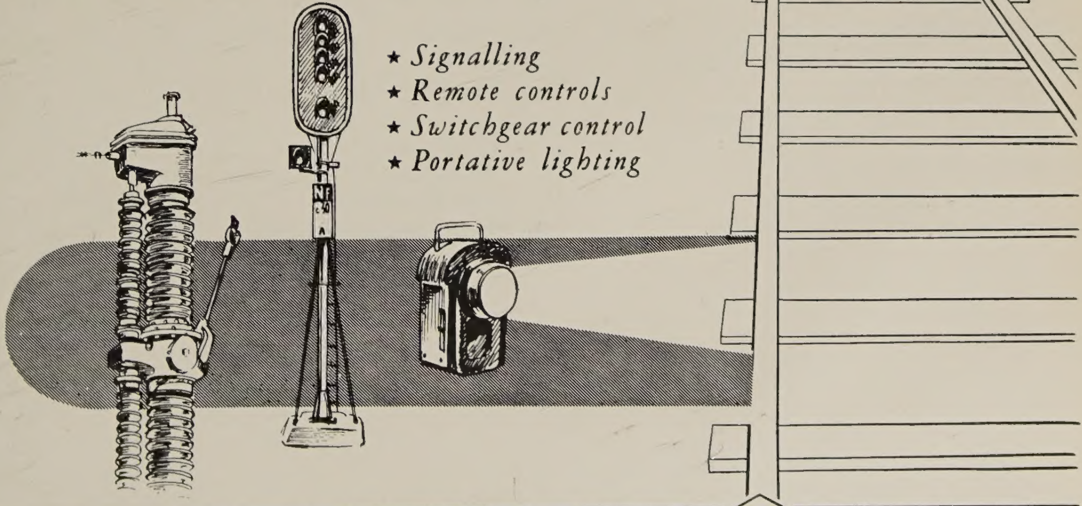
VOLTABLOC

A storage battery operating

without giving off any gas
inside a hermetically sealed container

with the VOLTABLOC
maintenance obligations are over

- ★ *Signalling*
- ★ *Remote controls*
- ★ *Switchgear control*
- ★ *Portative lighting*



ADEP PUB.

SOCIÉTE DES ACCUMULATEURS FIXES ET DE TRACTION
SOCIÉTÉ ANONYME AU CAPITAL DE 656 MILLIONS DE FRS . ADR. TEL. : SAFTALCALIN-PARIS
SIEGE SOCIAL : R^TE^ NATIONALE - PONT DE LA FOLIE - ROMAINVILLE (SEINE) - TEL. : VIL. 98-50
USINES A ROMAINVILLE - ANGOULEME - BORDEAUX

SAFT

Alphabetical Index of Advertisers

Firms :		Specialities :
Belships Company Limited	IV	World-wide heavy-lift service.
Brugeoise et Nicaise & Delcuve	VI	Railway rolling stock and fixed equipment.
Crossley Brothers Ltd.	V	Diesel locomotives.
De Dietrich & Co.	II	Track equipment and rolling stock.
English Electric Company Ltd (The) . . .	—	Railway electrification.
Ericssons (LM) Signalaktiebolag.	—	Railway signalling.
Exors of James Mills Ltd.	—	Rail and wheel lubricators.
General Electric Company Ltd of England	—	Electrical traction equipment.
Gregg (Sociétés)	—	Railway rolling stock.
Hasler (A.G.)	—	Speed indicators and recorders.
Matisa Equipment Limited	VIII	Permanent way equipment.
Metropolitan-Cammell Carriage & Wagon C°. Ltd.	—	Lightweight railway coaches.
Metropolitan-Vickers-GRS Ltd.	—	Signalling equipment for railways.
P. & M. Co (England) Ltd (The)	IX	Rail and flange lubricators.
Pressed Steel Co Ltd.	—	Wagons.
S.A.B. (Svenska Aktiebolaget Bromsregulator)	—	Automatic slack adjusters.
SAFT (Société des Accumulateurs Fixes et de Traction)	XI	Batteries.
Scharfenbergkupplung G.m.b.H.	X	Couplings.
Siemens and General Electric Railway Signal Co. Ltd.	VII	Signalling equipment.
S.K.F. (Société Belge des Roulements à Billes)	—	Axleboxes.
Superheater Company (The).	X	Superheaters for locomotives.
United Steel Companies, Ltd. (The) . . .	III	Railway materials.
Westinghouse Brake & Signal Co., Ltd. .	I	Railway signalling. Brakes.

M. WEISSENBRUCH & Co. Ltd.
Printer to the King

(Manag. Dir.: P. de Weissenbruch,
238, chaussée de Vleurgat, XL.)

PRINTED IN BELGIUM

Edit. responsible : P. Ghilain